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BRIEFLY TOLD.

THE EDUCATION OF MACHINISTS, FOREMEN AND MECHANICAL ENGINEERS.—At the last meeting of the American Society of Mechanical Engineers, held in this city the first week of the month, those who attended were well repaid for the trouble, time and expense involved by such appearance. The proceedings were conducted in orderly fashion, without any cracking of whips, and the papers read and discussed were of the thoughtful and independent order characteristic of the papers that have been read before the Society. On the paper list was a contribution by Mr. Milton P. Higgins, of Worcester, Mass., who in his city occupies posts of prominence that entitle him to recognition amongst those well in front of mechanical engineering occupations and pursuits the country over. The paper by Mr. Higgins is virtually reprinted in extenso in the current issue of the JOURNAL, and for it we bespeak the careful attention of our readers, and more especially the conning by those who are interested in the future of the Gas Educational Fund as at present conducted by the American Gas Light Association. To begin with, especially regarding the text of Mr. Higgins's paper, one must admit that his subject lacked nothing in scope, and to end with, it lacked nothing in verdict; for, having gone carefully through its lines, one is compelled to the determination that machinists, foremen and mechanical engineers are made, not born. Mr. Higgins, having declared some of the difficulties that the successful machinist must have surmounted, going on to enumerate the hurdles that the successful foreman must take, remarks: "If the position of machinist is a hard one to fill, what is to be said of that of foreman? * * * Nothing else is more difficult than to find men capable of filling such positions. * * * I believe that the most difficult position to fill is that of shop foreman. The position of president, treasurer, mechanical engineer, salesman, etc., need not wait a day for applicants, but the man who is fitted to manage the practical details of a machine shop successfully is a rare man, and there is no other scientific or professional man whose services are in surer demand than his." Much more could be quoted from the paper than is given here to show that while Mr. Higgins believes in teaching he also believes in learning, and that his tendency is to favor the latter. In other words, having escaped from one's teacher (for one teacher may not belong to all men), it might be well to benefit from the thoughts and practice of others who were also taught. In fact, a careful and "cudding" study of the Higgins presentment chiefly brings out the produce that when school ends experience begins; and that those who remember their scholastic pasture to the bitter end may find that leeks were mingled with the clovers. Mr. Higgins's paper is especially applicable to the state of "gas engineering" just now, in which art there are many men of many minds, particularly in respect of the ability of the "engineers" to make securities rather than gas.

"THE USE OF THE SLIDE RULE."—We are in receipt, from Messrs. D. Van Nostrand Company, of New York, of a copy of "The Use of the Slide Rule," by Mr. F. A. Halsey, whose editorial connection with the *American Machinist* is widely known. The tome is small, is neat and is well worth the price put upon it by its publishers. In all frankness, Mr. Halsey says, by way of preface, that the book, which is mainly a reprint of a series of articles that originally appeared in the *American Machinist*, is to be taken as an instruction book rather than as a treatise. Continuing, he remarks: "Such real difficulties as the slide rule offers to the student are carefully pointed out and the best methods of overcoming them are given, and this, together with the warning against too rapid progress and the pitfalls of slide rule gymnastics, will, it is hoped, do something to promote the use of the most valuable labor saver within reach of the average consulting engineer." In our belief Mr. Halsey's book will be of much advantage to the slide rule user.

NOTES.—On the first of the year Mr. William J. Hill takes charge of the gas division of the properties of the Erie (Pa.) Company. This corporation is the successor to the properties of the Erie Gas Company, the Home Heating Company, the Merchants and Manufacturers Electric Light Company, and the Welsbach Light Company, all of Erie.——Mr. Philip Cross has resigned the position of Superintendent to the Syracuse (N. Y.) Gas Company.—A correspondent, writing from Butte, Montana, under date of the 8th inst., says: "At a meeting of the Butte Gas Light and Coke Company, held early this week, the resignation of Mr. A. D. Hopper as President was accepted, and Mr. James S. Watson, of Chicago, was chosen in his stead. At the meeting the reports of the Company's growth, submitted by its Manager, Mr. R. S. Fuertado, were accepted, as they well might have been, with serenity."——The Philadelphia *Inquirer* of recent date said: "Rumors of a change in the management of the Camden (N. J.) Gas Light Company have been in circulation for some time. That there has been a change in the owner

ship of stock of the Camden Company is not denied. It was admitted by an official of the Company that the large block of stock owned by Mr. Benjamin F. Archer, President of the Company, had been disposed of." Secretary Watson declares that the control of the Company, however, has not passed out of the hands or control of residents of Camden.

——The following is the main text of the ordinance asking for bids for the exclusive franchise for the supply of gas in Covington, Ky., for a term of 20 years, etc. The bids were to be opened to day :

Be it resolved by the General Council of the city of Covington, Ky., that the City Clerk shall within one week after the passage and approval of this resolution, and he is hereby directed to advertise by two insertions each week, for two weeks, in the Cincinnati *Enquirer*, Cincinnati *Commercial Tribune*, Kentucky *Post*, Cincinnati *Times Star*, *Volksblatt*, *Volksfreund*, *Freie Presse* and New York Stock Exchange, that he will, on a day to be fixed by said Clerk, not earlier, however, than two weeks after the first insertion in said papers, receive sealed bids for the exclusive franchise of entering in and upon the streets and other public places of the city of Covington, Ky., to lay and maintain pipes for conveying gas to consumers in and out of the city of Covington for a term of 20 years from the date of the granting of this franchise. All bids shall be subject to the following conditions:

1st. Gas shall not be supplied through any pipe laid under said franchise until after October 28, 1902.

2d. All pipes shall be laid under the supervision of the City Engineer, and in such manner as by general ordinance may be provided.

3d. Not less than 20 miles of pipe shall be in the streets and public places of the city of Covington ready for use by October 28, 1902. Provided, however, that if the laying of the said pipes is prevented by injunction or other legal process, that the time the laying of said pipes is so interrupted shall not be computed, and within one year after October 28, 1902, pipes shall be ready for use in all streets and public places in which pipes shall have been laid in the city of Covington by the Covington Gas Company, October 28, 1902. Gas mains shall be extended from existing gas mains in and along any street or public place whenever the abutting property owners give satisfactory guarantee that the net revenue from sale of gas in the extension shall equal 6 per cent. on the investment, or whenever the city guarantees the same.

4th. The gas supplied shall be manufactured in the city of Covington, unless it be natural gas, and illuminating gas shall always be maintained at not less than 16 candle power, and fuel gas, if conducted in separate mains, shall always be maintained at 600 heat units per cubic foot; provided, however, that if fuel gas and illuminating gas be supplied through the same main that such gas shall always be maintained at 16 candle power.

5th. In laying pipes and the constructing or improving plant, where it can be done, none but Covington union labor shall be employed.

6th. The city or its assigns shall, by giving one year's previous notice in writing of such election, have the privilege of purchasing at the expiration of the 20 years the gas plant, pipe system, real estate and all property used in and about the manufacture and distribution of gas to consumers at an appraisal to be made by 5 residents of Kentucky, 2 of whom shall be chosen by the city or its assigns, 2 by the grantee of this franchise and the 5th by the 4 so chosen.

7th. If the same gas is supplied for fuel and illuminating purposes it shall be furnished consumers through the same service pipe, where the same is large enough to permit it.

8th. Bidders shall state separately the price per 1,000 cubic feet of illuminating and fuel gas to consumers, giving the discount to be allowed for payment of bills within 10 days after they become due, and bidders will state separately the price at which they will supply gas to the city of Covington for use upon its streets and public places and in its public buildings. The city of Covington, however, in no way to be obligated to take gas from the grantee, but it may light its streets and public buildings with any illuminant. It shall, however, have the right to be supplied with gas by the grantee at the prices bid from time to time and for such period as it may desire. All bids shall be accompanied by a certified check for $10,000, which shall be forfeited as liquidated damages to the city of Covington if the bid is accepted and the bidder or his assigns fail to execute bond and contract in conformity to his bid. Any and all bids may be rejected.

9th. Within 20 days after the franchise herein provided is awarded the successful bidder or his assigns shall enter into a written contract, to be approved by the General Council, embodying the terms of the bid, and also execute bond with local personal security acceptable to the General Council or an indemnity company authorized to do business in Kentucky in the penal sum of $100,000, conditioned for the faithful performance of its contract.

Electrolysis in American Cities.

[A paper read by MR. F. A.W. DAVIS, at the Cincinnati Meeting of the Central States Water Works Association.]

The electrical current is so subtle and so destructive that we cannot attach too much importance to it. Some systems may show no effects of it for years to come, but nevertheless the destruction is going on and in a very definite manner. I have found water mains affected without showing even the breaking of the coating of the pipe. Almost invariably when you find the sand, gravel and earth adhering firmly to your pipe, there is destruction going on, although the pipe itself may show no visible evidence of the fact. If you analyze the earth, which is so hard and so firmly attached to your pipe, you will find that the iron of your pipe is being carried into the earth by the electricity, leaving only the carbon. Again, I have found pipe having a graphite color and feeling smooth, but upon removing the earth and running the point of a knife over the metal, the knife entered soft spots in the pipe. This is the beginning of the pitting of the iron. In lead services, I have found the erosion or destruction of the pipe to be rapid, four months being sufficient to destroy a ¾ lead service weighing 3 pounds to the foot. The action of the electricity upon the lead pipe differs. In one case I found fine, bright threads of lead in the earth. In other cases I have found the lead charred so that it would be hard for you to determine that it was lead. In still another case, I found the electricity had produced a substance like white lead. Taking it in your fingers and mashing it, it would leave your fingers white as would white lead used in paint.

We have found as many as 50 volts coming from a meter connection. In one building the current was so strong that, when the water pipe was cut in two, a piece of iron the thickness of a shovel placed in the opening was soon melted by the current. In one case the singular spectacle of a fire hydrant apparently on fire was seen. Gas had escaped from a gas main and was coming up around the fire hydrant and had been ignited by the current from the street car company's line, passing from the casing to the hydrant. In several instances the Manufacturers Natural Gas Company, of Indianapolis, found the current so strong that, when a pipe was separated, the gas ignited from the sparks and endangered the lives of the workmen, and in two instances almost set fire to buildings near by.

Damaged Pipe from Kansas City, Kas.

Pipe from Bridgeport Hydraulic Company, Bridgeport, Conn.

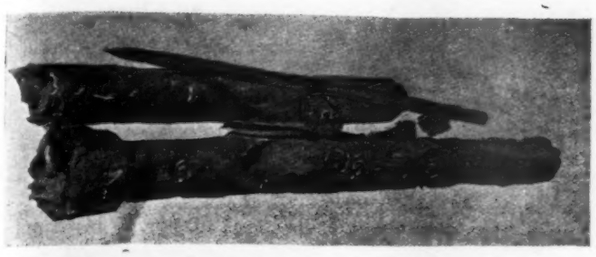
An illustration is presented of a cast iron 4 inch gas main taken out near the power house of the street car company in Indianapolis. The destruction of this pipe is peculiar and more complete than any I have heretofore seen. Pieces came out of the pipe in places as large as a dollar, and there was no weight to these pieces that had been scooped out by the electricity. Where the spigot end of the pipe enters the bell it has the appearance of burnt iron.

Knowing that it is quite difficult for the ordinary business man to understand "volts," "amperes" and "watts," I sent out over the United States circulars asking water works companies for their experience and the effect of the electrical current of the street railways upon their pipe and services and information in untechnical language. The questions and responses may be summarized as follows :

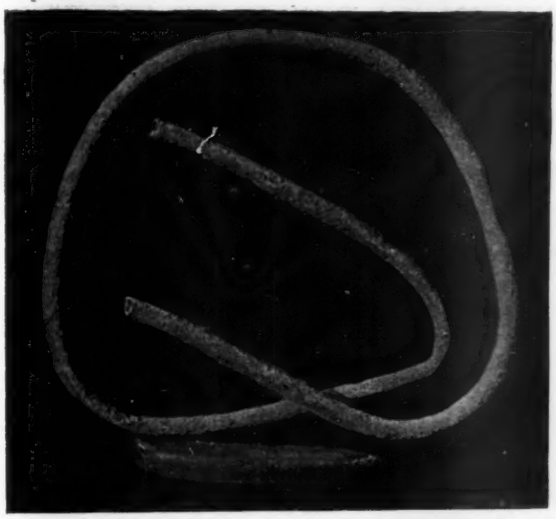
1. Have you any experience with electrolysis ?

Seventeen reply no experience. Sixty-seven answer yes.

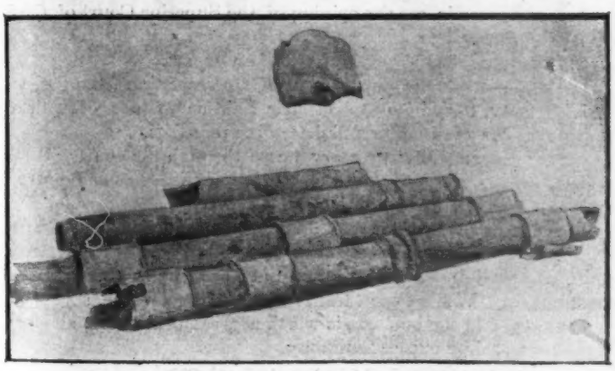
2. Where and in what manner has it affected the lead, wrought and cast iron in your system ?



Four-Inch Main of Indianapolis Gas Co., near Power House, taken out Aug. 9, 1899.



Indianapolis Water and Lead Service—Four Months.



Holes Mended with Split Sleeves, Albany, N. Y.

Sixty-six answer lead and iron services and cast iron pipe affected to such an extent as to render the parts affected utterly worthless.

3. Have you ever had an expert examine your system? If so, what were his conclusions? Please give his name and address.

Fourteen say they have not had examination made. Eleven cities report having an expert.

4. Has the street car company done anything to relieve the situation?

Seventeen report nothing done to relieve the situation. Thirty report that the car company had made an effort to relieve the difficulty.

5. Has the effort been in earnest, and what has been the result?

Twenty answer, no effect. Seven report efforts of the street car company successful, and twenty partially successful.

6. In what manner has the street car company endeavored to relieve the electrolysis?

Twenty do not make any statement as to the efforts of the company. Twenty-seven report car companies have endeavored to relieve the electrolysis, some by overhead return wire, some by wire laid between the rails, and some by connecting the pipe service to the rails, and some by bonding the rails and mains. Bonding rails unsatisfactory. Best results from overhead return wire or wire laid in the conduits underground. The very highest results have been obtained by having the return wire laid in a conduit.

7. Has the street car company paid you for damage done? If so, how much?

Seventeen report not having received any money; some of the 17 report they have as yet made no demand for damages. Thirty have received sums varying from $16 to $500. Others report street car companies have paid to private owners the cost of new service. Some report claims pending; some, preparing for litigation. Some report that the street car company has paid for labor and material when services were replaced.

8. What do you recommend, being guided by your experience, to relieve electrolysis?

Six did not answer. One says he gives it up. One, not well enough acquainted with the effort to relieve electrolysis, and would be glad to be advised in the matter. One says remedy has not been found yet. None of the schemes proposed from time to time appear to safeguard the affected underground interests. One says perfect rail connections for return current and double trolley wires. One superintendent has no suggestions to make at present. One says experience too limited to offer recommendations. One recommends that street car company be compelled to take care of all their return currents. Thirty-five report that the rails should be bonded and return wire of sufficient size be used to carry all the overflow currents back to the power house, at the expense of the railroad companies.

9. Are you now in litigation with the street car company?

Forty-seven reported no litigation.

10. How have your demands for redress been met?

Seven do not answer. Thirty-nine report that demands have been

Six-Inch Main between 11th and 12th Streets, Milwaukee, Wis., Burst April 29, 1899.

Four-Inch Branch and Valve, 202 Water Street, Milwaukee, Wis., Burst Dec. 2, 1898.

Gas Main Taken from Alley South of 15th Street, Indianapolis.

Through the hole shown in the photograph made by the electric current, the gas escaped, coming up through the ground in the alley. It then found its way into the cellar of an adjacent house where an explosion occurred, Oct. 3, 1899, almost completely wrecking the house and seriously injuring three persons.

made. One reports claims in hands of attorney. One, claims ignored. One, partial. One, claims to present. Two that the street car company agrees to remedy the defect. Four report bills settled.

11. We are of the opinion that an overhead wire by which the current can be returned to the power house is the best method. Do you regard such construction as adequate to afford relief?

Seven do not answer. Eleven answer yes. Two answer no. Two cannot say. Three report the return wire in condults as the best method. Thirty-seven report the overhead methods as likely to give relief, provided the wire is large enough to take all the current back. One says wire must be insulated. One, double trolley system best. One, not expert enough to say. One, the best he knows of. Some regard overhead wire best solution so far. One, overhead wire gives relief. One did not think it practicable. One says: "I am not sure that there is a complete remedy." One, overhead wire is the safest.

12. If you are not in litigation with your car company do you know of any water works or gas company that is?

Four cities reported litigation.

13. How has the electrical current from the street car company system affected the fire alarm system of your city?

Fourteen reported damage to the fire alarm system.

14. Have you any knowledge of fires having been started by the electrical current of the street car company?

Forty-four have no knowledge.

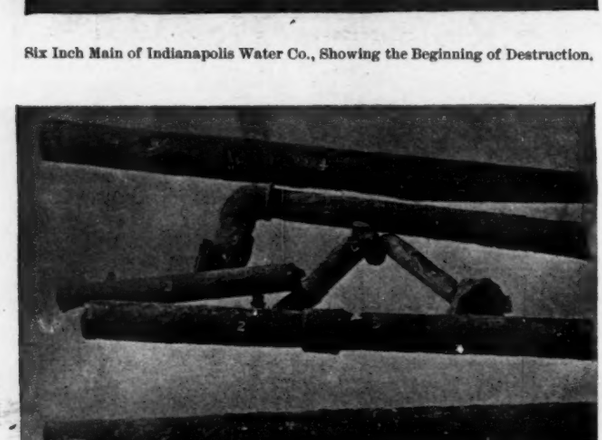
15. Under this number we will thank you for suggestions.

One says matters should be laid before higher courts.

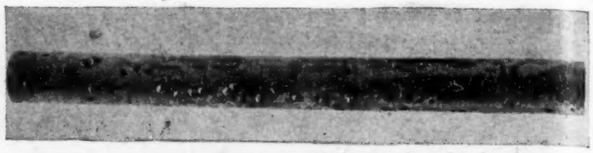
One recommends friendly effort with the street car company.

Side and End Views of a Section of 8-Inch Water Main, Showing the Result of about Four Years of Electrolytic Action.

Six Inch Main of Indianapolis Water Co., Showing the Beginning of Destruction.

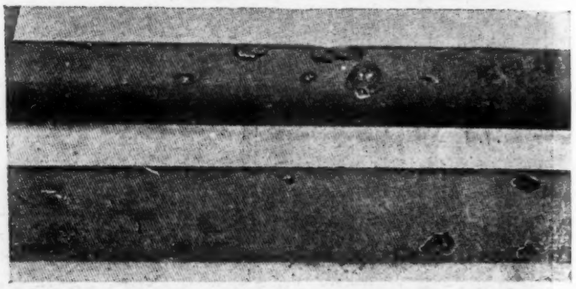


Samples of Pipe Taken from the Consumers Gas Trust Company's System in Indianapolis, Destroyed by Electrolysis, some of them in Less than 18 Months.



A Damaged Pipe from Dayton, Ohio.

Iron Service Pipe from Muncie, Ind.



Damaged Pipes from Lansing, Mich.

One says that he is at sea in the matter, and will be only too glad to pay his full share to ascertain the most satisfactory remedy for the difficulty.

One recommends that we "fight it out" ourselves.

One recommends, see the opinion of the Superior Court of the State of Washington.

One recommends the employment of an expert.

One recommends the employment of a commission from gas, water, street railway, telephone and electric light companies. Let the commission make examination and determine remedies.

One recommends that we carry a case through the courts.

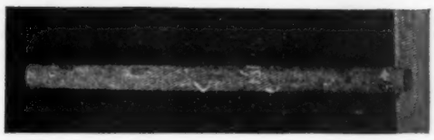
Note—Please report to the writer further experience and destruction that may occur between now and May 1, 1900.

These replies are from men of long experience and conservative in the water works business, and their statements that their systems are being damaged by electrolysis are not based upon theory, but upon absolute fact. While expert testimony is of great value, statements of those engaged in the business is worth a great deal more, and cannot be controverted by expert testimony.

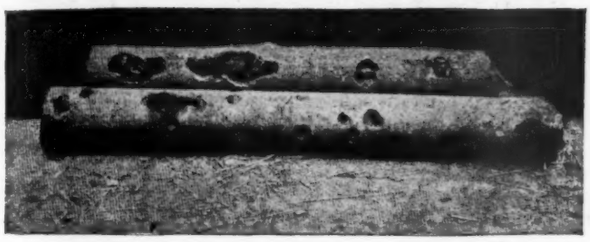
From the responses, you can realize what great destruction is going on all over the country. It has been predicted by some writers that in ten years time water and gas pipes will be utterly destroyed and that we will have to substitute glass for water mains. Such a proposition as that cannot be entertained one moment by any board of trustees or corporation management of water works. The electrical corporations operating street railway cars are the aggressors and are the destroyers of property, and they alone should provide a remedy. Franchises have been granted street railway companies after the water works, and surely a city cannot grant a franchise to any corporation which will destroy the property of the owners of a previous franchise for gas, water or steam heating. So little attention has been paid to this great destroyer that we have yet to have a decision by the courts; but the time is now at hand when the courts must render a decision, and in my judgment there can be but one opinion, and that is that the street car companies being responsible for the destruction of the water and gas pipes and services, must respond for the loss and prevent its repetition.

Just one moment's reflection on your part and you will be amazed at the many thousands and millions invested in water and gas plants which are subject to destruction by the electrical current. Some are under the impression that it requires a very strong current to destroy the mains and services of a water company, but that is entirely a mistake. Prof. William Jackson states that one-thousandth of a volt pressure will cause electrolytic action, and some of the worst cases of corrosion, in Boston, have been found on iron pipes where there was

Lead Service, Indianapolis Water Co.



Iron Service, Elwood, Ind.



Pipes Damaged in Springfield, Ill.

only 1½ volts between the pipe and ground. It must be kept in mind that rapid and extreme destruction depends largely upon the salts of the earth. Reports sent in show that towns where but few electric cars are run are suffering as much, if not more in proportion, than the larger cities. I think this can be accounted for by there being a great many more good conductors in the large cities than in the small towns. It is well known that if the electrical current did not leave the pipe there would be no destruction. In water mains the lead and yarn in the joints cause the electricity to skip over the bell and enter the pipe on the spigot end and continue to do this until it reaches the place where it was generated. I have not seen in all my examinations any pipe that has been destroyed from within, but I believe it a possibility from the cause I have mentioned, provided the water contains proper salts, as it does sometimes. The destructiveness in our city has not been confined to the pipe services near the street car company's power house, but it has been found miles from it and where the current was not very strong.

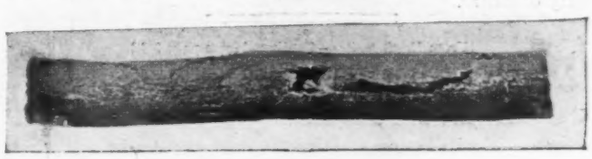
The Indianapolis Water Company had an electrolytic survey made of its lines, showing the danger districts. We found at the West Wash ington street power house 1,300 amperes as a maximum and 1,100 amperes as the constant average. Multiplying 1,100 amperes by 8.2 volts gives 9,200 watts. Directly in front of the power house we found we were returning 1,400 amperes at an electrical pressure of 9.1 volts; 1,400 multiplied by 9.1 gives 12,700 watts; 12,700 divided by 746, which represents a horse power, gives a little over 16 horse power.[1] From these figures you can readily see the overflow from the rails that exists in the system in Indianapolis. The rails in the Indianapolis system have been bonded by the largest wire used and they have been connected to our pipe. Yet, notwithstanding these precautions, we can say that a very large part of the current is not returned by the rail, and, to my mind, it settles beyond controversy that the bonding of rails and connecting the same to the water pipe are totally inadequate.

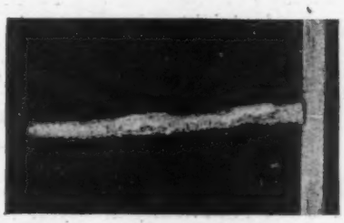
The replies indicate that the bonding of the rails and mains has only been successful in a few instances. The method is all wrong in prin ciple and not justified under any circumstances. There is no good reason why any water department should furnish the street car company a means of returning to the power house the electrical current created by it. Sometimes the railroad companies bond the rails and pipes surreptitiously; and again they say, "Let us bond your mains and no harm will be done them." The heat generated by the current and the shunting of the current at the joints cannot be other than injurious. A main charged with an electrical current is in an unnatural condition and is dangerous to workmen even if there be no damage to the main. Professor L. I. Blake, of the University of Kansas, says, in regard to the resistance of cast iron joints, as commonly made with oakum caulking and melted lead, "I have found the resistance of three old joints cut from 6 inch cast iron mains about 200 times that of the pipe. In 25 lengths of 4-inch pipe, as it lay in the trench, I found resistance of the joints 110 times that of the pipe." In the cast iron 4-inch main of a gas company in the city of Indianapolis, the spigot end of the pipe was almost entirely destroyed, while the pipe each side of the joints was destroyed in places. The pipe is complete evidence in itself that the resistance of the joints is many times that of the pipe and is damaging. Bonding the rail and the pipe cannot and does not provide against its destruction. The railroad companies, by using the mains, are saved a large outlay for return wires; but does that furnish a good and sufficient reason for using the mains for the return of the current to the injury and damage of the pipes? Is there any law or equity in such proceedings? Is it not common-sense equity and justice that a street car company should provide for the return of the current created by it to the power house by means provided, at its expense, for that specific purpose?

The practice of tying (or bonding, as it is called) of the rails together at the joints with a large wire is simply absurd, A moment's reflection will convince anyone that the conductivity of the rail is at least ten times greater than that of the wire. Therefore, if the rails will not carry the current back to the power house, how can a small wire? What can be more fallacious than the wiring of the water pipe to the rail? Everyone knows that the electrical current escapes from the rail. If the rail was a perfect conductor there would be no escaping current. What benefit can possibly be obtained by wiring the pipe to the rail, which demonstrates by the current on the pipe its inability to return the current to the power house? The pouring of iron around the joints is not much better than the small wire, because there is a covering on the rails of rust and dust, which prevents perfect contact. The water departments should not make the mistake of suggesting how the railroads shall take care of the overflow currents, but demand that they do it.

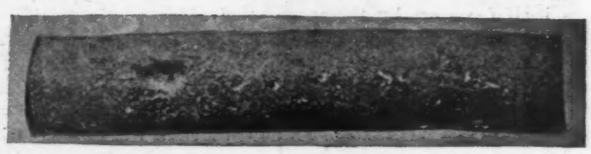
From our experience it would seem that there is no absolute remedy for these conditions known at the present time, but that the situation can be almost entirely relieved if a return wire, insulated, of sufficient size with low resistance, be laid between the rails under the ground in conduits.

While I express my belief in the adequacy of the return wire, I am firmly of the opinion that the remedy should be provided by the street car company, and that no loss or damage should be sustained by any water department in the country. This remark applies to suburban lines as well as lines in cities. In the reports it is shown that in Philadelphia the suburban lines had given more trouble than the lines in the





Lead Service, Newport, Ky.



Effect of Electrolysis on an Iron Water Pipe in 30 Days' Exposure.

1. The electrical terms used in this paper will be better understood, perhaps, from the following explanation of them: By ampere is meant flowage. An ampere meter measures the flowage like a water meter. Volts represent pressure. Volt meters show the pressure as our recording gauge does. Watts are units: 746 watts represent 1-horse power.

city. I do not see that there can be any justification whatever for continuing a system of transportation that is detrimental to the water mains which furnish the citizens with a necessity of life, health and cleanliness, and a protection from fires for their property. In other words, a water works is more important to a city than a street car system. Al most universally the water works are constructed before the street car lines. In our city, under the new contract, the charter or franchise granted puts the power in the hands of the board of public safety to require a remedy to be applied to prevent the destruction of the water company's property and that of the citizens. Up to the present time the street car company in the city of Indianapolis has refused to pay the property holders for damage done to their services, and their accounts are now in the hands of attorneys to enter suit. We have advised the citizens to await our efforts before the board of public safety to get the street car company to pay its bills and afford relief. The payment of claims by the street car company for damages to services or broken pipe is of too little consequence to be mentioned in connection with the destructiveness of the electrical current. No human being knows just where the damage in the system is being done, or to what extent, until a main bursts or a service gives out.

Throughout the reports received in response to our inquiry it was observable that there was reluctance on the part of many to antagonize the street car company, and, in fact, two companies stated that they did not wish to antagonize the street car compsny. I can readily appreciate such a position, because of the position occupied in a city by the street car company politically and otherwise, more especially its political influence. Besides, we have found some cities where the owners of the street car company were interested in the water com pany as well. There is another reason : No company likes to report any damage done or defect in its system until forced to do so. This is a natural feeling. In some cases it requires considerable nerve to do so, because any statements made that the systems are being damaged by electrolysis may affect the financial standing of the company. Another thing, many water works officials do not like to make known to the citizens the condition of a system owned by the city. The many millions invested in water works with the absolute certainty of the ultimate destruction of water mains is of such great importance that a superintendent or an engineer or a board of control cannot be justified in concealing the actual conditions, and when they know to a certainty that the systems and services of their respective cities are being destroyed, it is their duty to employ competent experts to examine them, and upon their report put forth their utmost efforts to prevent further destruction.

The electric current generated to propel the cars is alike in character in all cities, and if it is injurious in one city it is likely to be so in all. It obeys the same natural law in all cities, that is, to return to the point where it is generated by the route that offers the least resistance. The street car company having created the current is certainly bound in all equity and law to provide for its safe return without damage to the property of others.

[From *Engineering*.—Continued from page 922.]

American Competition.—No. XI.

By Mr. T. Guilford Smith, Buffalo, N. Y.

If I were asked whether it is possible to express in one word the reason why American industries are able to successfully compete at the present time with those of other countries, I should say that that word would be greater *adaptability*. This phase of mind prevails in the United States from the master to the workman, and whether it is expressed by a willingness on the part of the managers of the various industrial works to meet the buyers as to deliveries, terms of payment, etc., or whether it is a willingness on the part of the workmen to conform to necessary conditions in order to insure success, adaptability is the word.

This willingness on the part of all workers in America has been becoming more and more evident from year to year as the necessities arose, and particularly since we have been endeavoring to obtain a footing in foreign markets. Taking iron and steel as typical, it has shown itself for years by the substitution of automatic machinery, wherever it was possible, in all forms of labor. It has shown itself also in the concentration under one hand of the mining and transportation of raw materials, in the workshops, and in the concentration of facilities for the distribution of the product.

The rigidity said to characterize our foreign competitors when brought face to face with intending buyers, and which in our opinion has had so much to do with throwing the trade with us, has been carefully avoided. If a buyer wanted a delivery which could possibly be made, every effort was made to meet his wishes. If a buyer wanted terms of payment with security for its ultimate accomplishment, every effort was made to meet this requirement; and so, from the mining of the ore and the making of the coke to the turning out of the finished rail, plate, or other form of steel, every effort was made to meet the market, and to suit the wishes of the buyer.

In this frame of mind, the very large concerns here have, for many years past, been devoting their energies to reducing the cost in every department of the business, whether it is the raw material, the transportation of the raw material, the substitution of automatic machinery in the mills, or a reduction in the cost of distribution. All these points have had most careful and earnest study, and we believe that the consummation has been reached when such concerns as the Carnegie Steel Company, Limited, mine their own ore, make their own coke, transport the ore in their own vessels, make their own pig iron, invest great sums of money in labor saving machinery of all kinds, and finally, distribute the finished products through their own agencies. It is not necessary to say that all this has been attempted before, but it has never been so successfully accomplished, as is shown not only by the achievements of this company, but by those of its American competitors who outbid others in the foreign market. This is particularly true of all branches of iron and steel manufacture, and is likely to continue.

In order to insure a steadiness of market and the least possible fluctuations, some means must now be considered and obtained by which the price of pig iron can be kept within moderate limits, and the prices of raw material upon which all finished products depend, must be made as stable as possible.

The immense deposits of coal and ore, and the great reduction made in transportation costs, have given this country many advantages, of which, however, they could not avail themselves for many years, until the other conditions, named above, had been successfully attained. The evolution of these successful conditions has been very much aided by the improved methods of technical education in this country and by the rapid accumulation of capital, both of which are absolutely necessary to make this present condition permanent, and to have the United States continue to take an increasingly prominent stand in the world's markets. As rapidly as possible, banking facilities must be perfected and steamship lines under the American flag started, so that when the American manufacturer wants to ship his goods to any part of the world, he can do so by the most direct routes and at the lowest cost, and obtain payment therefor in an equally direct way without paying toll to any other nation.

It must not be supposed that I am unaware that other nations have been busy in recent years in respect to the improvements in all the points I have touched on. It is true that great improvements have been made in blast furnaces, and rolling mill machinery and practice, not only in Great Britain, but in Germany. These efforts, however, are all attended by an increase in the rate of wages paid, so that while the improvements were made, they did not really decrease the cost of the manufacture. Added to this must be the constantly increasing cost in the other countries, of ore, coal and coke, due to the increased depth at which the mines are being worked and the consequent increase in the amount of labor; so that, take it all in all, the competitors of the American ironmasters have been rather handicapped by the increased cost, not only of wages, but for raw materials, which is another element in favor of the American manufacturer. I do not see any prospect of a decrease, but rather a prospective increase in cost to all the competitors of the American manufacturer, and while automatic methods and improved practice may keep these down to some extent, there can be no decrease in the cost, but probably an increase due to the increased cost of the day's wages. Here again comes in the lack of adaptability on the part of the workmen abroad and their unwillingness to accept piece work and contract work, so as to get out the greatest amount of finished work within a given time. This adaptability in the case of the American workman has been of great service, and is an important element in the increased production of manufactures; and I am happy to say that the tendency is on the increase, so that day labor is generally only employed for the rudest forms of work. Recruits from the day laborers are constantly obtained for the higher grades of work, particularly in the use of tools, automatic machinery, etc., so that there is a continuous improvement in the wages paid to all workmen with a diminution of the hours of work; and notwithstanding this, no increase in the cost of the manufactured product, due, as I am contending, almost entirely to the adaptability of the workman to changed and changing conditions.

The personal equation not only of the managers but of the workmen in America in almost all branches of manufacture, is shown by the speed to which machines are geared, which involves more rapid mental processes on the part of workmen in America than elsewhere. This has an apt illustration in the efforts made by the Swiss workmen to adapt American machinery to the work of watchmaking. Although identical machines were bought and sent to Switzerland, yet the speed at which they were geared was so much higher than that to which the Swiss workmen were accustomed, that they were unable to turn out the same amount of finished work in the same time as American workmen, and when it was attempted, so much bad work was done that the experiment was abandoned, and the scheme failed because of the inability of the Swiss workman to adapt himself to the increased speed of the American machinery. This has been found true with other machines in other branches of manufacture, and is therefore to a certain extent the personal equation of the race; it seems to me that this is a most valuable unit in favor of the American workman and of American competition, and one which should not be overlooked in estimating the causes which have contributed to this important result.

How much of this is due to racial peculiarities, how much to environment, including climatic conditions, it is impossible to say, particularly as we find that a foreign born workman soon acquires the same quickness and habit of thought as the native-born; but it is certainly an element to be reckoned with. It is a pretty well established fact that it takes about twice the number of foreign men to do the same amount of work in a given time as is done by American workmen.

It would seem that the immense sums of public money devoted to public instruction in all States of the Union, and the very large sums given every year by private individuals to institutions of learning, both show the silent appreciation by all classes of the community, of the great importance of the education to all classes of citizens. Probably in the last twenty years, more and more of this money, and more and more time, have been devoted to technical education in various phases, and I am quite sure that the nation at large is reaping the benefit of this work at the present time; the widespread influence of education should not, therefore, be omitted in considering the success of American manufacturers in the struggle for business in the world at large.

We must not, of course, underestimate the efforts being made in Great Britain in the direction, and even at this late day we may still thank the late Prince Consort for the impetus given to technical education by the Exhibition in London in 1851, and the annually recurring results due to his efforts at that time. The British nation certainly did not appreciate how much they were behind their neighbors in Europe at that time, and were only brought to the full realization of it by comparison in that Exhibition, which might be said to have been held mainly for the purpose of showing them how much education of all kinds was needed, and technical education particularly.

So far as the future is concerned, it seems to me that the permanence of the supremacy of American manufactures in competition with the rest of the world is assured, not only for the reasons already given as to the adaptability and the peculiarities of race and temperament, but also from the fact that so many of the natural resources of the country are as yet undeveloped, and those that have been worked even for a number of years are still in the earliest stages of their development. This is particularly true of the ore deposits, not only of Lake Superior, but also of some parts of Pennsylvania, and largely in the Southern States generally. It is equally true of the bituminous coal deposits which are so widely distributed as to be a basis of many industries, some of which are in their infancy, and others that have yet to be started.

The great importance of these coal deposits, not only to the manufacturing industries of the country, but for export as a means of supply to other countries, can hardly be over estimated. Hitherto Great Britain has been largely the coal merchant to the world, except to the United States of America. Her coal laden vessels are found everywhere, and they seldom return in ballast. This has been a condition of trade for so many years that the channels are well established, but it can scarcely be regarded as permanent, for every year coal from Virginia, and from other United States deposits near the seaboard, is being constantly introduced into new markets. Under these circumstances, I can see no reason why the future of the American export trade for coal, perhaps for ores, and certainly for pig iron and manufactured products, does not seem more likely to be constantly extended in competition with other countries, than to be curtailed for any reason whatsoever. The changing conditions of exchange by which New York is dividing with London the money center of the world, is strengthening this new position every day, and the march of commercial events in the future, as far as it can be foreseen, seems to tend only in one direction, westward.

Gas Stoves in Australasia.

The *Metal Worker* says that the Australasian colonies offer a market for gas cooking and heating stoves that perhaps is not quite receiving the attention its growing importance deserves from American makers of goods. Australasian correspondents of the Philadelphia Commercial Museums touch on the local conditions in a way to be of interest to the American trade.

Trade in Australia.—According to a correspondent at Melbourne, Victoria, the principal business in gas stoves in Victoria is being done at present by the local makers, Galliers & Klaerr, and Wallise Bros., of Melbourne. The goods are of ordinary quality, and are seldom enameled inside. A large number of stoves have been imported, principally from Fletcher, Russell & Co., Warrington, England, and Wright & Co., of Birmingham, who are very large and well known makers. The tendency in Victoria has of late been to use imported stoves. Wm. Parkinson & Co., of London, have also been supplying the market.

In New South Wales, which is a free trade colony, nearly the whole of the trade has been done by the two English firms mentioned. On account of the demand in Queensland, South Australia and West Australia not being sufficient to support a local industry of the kind, the stoves of the English maker are generally used. Under the federation of the colonies, which will take place next year, there will be a uniform tariff, and it is expected that the local manufacture of stoves will be taken up with more vigor both in Sydney and Melbourne, as there will be then intercolonial free trade. English makers of gas meters have already started in the colonies, and it is said that probably some English makers of gas stoves will also open works there.

The tendency now is to use a good, high-class stove in preference to the very cheap, unpacked, unenameled stoves, of which there were quantities used eight or nine years ago. In the larger towns a higher price can sometimes be obtained than in the smaller, but for the general consumer £4 10s. ($21.87) to £5 ($24.30) is usually the price paid for stoves suited to the use of from five to seven or eight persons. This is the selling price in Melbourne and Sydney, and there is a fair demand for the best class of stoves from £5 ($24.30) to £6 10s. ($31.60) Fletcher's Palace stoves, Taunton and Kensington patterns, are in most demand in Melbourne. The imported stoves are generally sent out in parts, all ready for fixing, and are made so that they can be easily put together and any parts duplicated. It is necessary to have patent removable porcelain enamel linings.

A large proportion of the Australian trade is done by gas companies. The Melbourne Gas Company and a few of the others let stoves out on hire, but the Sydney Gas Company, and most of the companies, usually sell outright. The correspondent thinks that catalogues from American makers would be received with much interest by the gas companies, especially in Sydney and Melbourne. In the warmer sections of Queensland, especially in Brisbane, Brockhampton and Townsville, gas stoves are being more generally used, and trade will open up there considerably during the next two or three years. The correspondent expresses the opinion that the English connection will be rather difficult to displace unless very especial novelties are offered. The correspondent says that the English firms are well represented and established in the colonies, and have laid themselves out for colonial trade, and he points out that freights are very much cheaper from England, and regular deliveries can be depended upon, which saves the keeping of large stocks. There is at least a twice-a-week service from England to Australia.

The duty on stoves entering Victoria is 30 per cent. ad valorem. They enter New South Wales free.

Trade in New Zealand.—The following is from a well informed correspondent at Christchurch, New Zealand:

"Nearly all the chief English makers do business in Christchurch. Fletcher, Russell & Co., and Richmond & Co., of Warrington, and John Wright & Co., of Birmingham, have the biggest run, and about in the order named. The upright oven, so familiar in Fletcher & Co.'s catalogues, is the only style which will command attention. The hot plate on top must be large and have at least three boiling burners in addition to large size grill. The grill is much used here, and must be a really good one to sell. Local manufacturers have been making cookers for the colony's requirements for many years, and although the stove has held its own with the best imported for general efficiency

and economy in consumption, a satisfactory grill has not been devised. The universal cry is that it must be cheap. In addition, the stoves must be attractive in appearance, as well as thoroughly efficient. The Christchurch Gas, Coal and Coke Company hire as well as sell on deferred payments; consequently a general supervision must be kept over the stoves for the sake of their own credit. The selling price, therefore, must be low. The profit is obtained from the sale of gas rather than the stoves.

"The climate has a great deal to do with the sale of gas stoves. Auckland is sub-tropical, and, therefore, the demand for cookers is very good. Wellington, further south, is a fair market. Christchurch is also fair, but at Christchurch a three months' winter season has to be met when it is too cold to rely on gas cookers. Dunedin is too cold to do much in these stoves. The freight charges are so high that every effort is made by manufacturers to make the cookers capable of being taken apart for export. As to gas fires, the demand increases from year to year. The fires in most general demand are of the "asbestos ball," cheerful kind. The smaller sizes, for offices, bedrooms, etc., are chiefly in use. These should be attractive as well as reasonable in first cost, and should give good heat efficiency on about 25 cubic feet per hour.

"There is always a demand for boiling rings, bath heaters, etc. Fletcher, Russell & Co. get the lion's share of this class of business, their goods being found invariably reliable. Auckland, Wellington and Christchurch have good showrooms and endeavor to keep the stock well up-to-date, and are, therefore, always glad to have brought to their notice any appliance that will further popularize the use of gas, whether it be for lighting, cooking, heating or motive power. The Welsbach system of incandescent gas lighting is very general in all large centers, and the demand for suitable fixtures is and will be active. It might be to the advantage of American stove makers to enter into correspondence with the Christchurch Gas, Coal and Coke Company, Ltd.

"The following are the towns where gas companies are doing business in gas stoves and fires; Auckland, carbonizing about 15,000 tons of coal; Christchurch, about 9,000; Wellington, 8,500; Dunedin, 8,000; Napier, 3,000, and Nelson, 2,000 tons of coal."

The Importance and Value of Lubrication.

A writer in the December number of *Mines and Minerals* thus treats of the subject named in the heading:

There is probably no factor which has a more direct bearing upon the cost of production per ton of coal than the lubrication of mine machinery, and yet it is doubtful if there is another item connected with the operation of a mine less understood by owners, their managers and engineers in charge.

Steam plants are equipped with boilers of the highest known efficiency; heaters are used that, by utilizing waste steam, will heat the feedwater for boilers to the highest point. Modern engines that will develop a horse power with the least amount of steam are installed, bends, instead of elbows, are placed in steam and exhaust pipes, so that the friction and back pressure may be reduced to a minimum. In a word, everything is done in the equipment of a plant to secure economy in its operation. After all this is done, frequently a long step is taken in the opposite direction by the use of an oil unsuited to the existing conditions, and those in charge of the plant are led to believe that the lubrication is all that could be desired, simply because the engines and machinery run quietly and the temperature of the bearings does not become alarmingly high. The office of a lubricant is not merely to secure this result, but, *primarily, to reduce friction and wear to a minimum*, and an oil that will do this is the best oil to use, no matter what the price per gallon may be.

Few realize the great loss in power due to the friction of wearing parts. One of the greatest living authorities on lubrication writes:

"It may probably be fairly estimated that *one-half* the power expended in the average case, whether in mill, mine or workshop, is wasted on lost work, being consumed in overcoming the friction of lubricated surfaces." He adds that a reduction of 50 per cent. in the work lost by friction has often been secured by a change of lubricants.

As one of many instances showing the loss that will occur by the use of inferior lubricants, attention is called to two flour mills located in one of the Middle States. One of the plants was equipped with a condensing engine capable of developing a horse power on 24 pounds of water per hour; the other plant had a simple engine, taking 30 pounds of water per hour. The plant containing the condensing engine was purchased by the owner of the plant containing the simple engine. The new owner of the plant was surprised to learn that the cost of operation per barrel of flour manufactured was equally as great in the new plant as in the old one. The engines were indicated, and valves found to be properly adjusted and the engines working within the economical range so far as load was concerned. The loss was then attributed to the boilers, but an evaporative test proved that there was no practical difference here, as the boilers, in both instances, were evaporating a fraction over 8 pounds of water per pound of coal. At this point the question of lubrication was taken up, and, upon the advice of an expert sent by a prominent manufacturer of lubricants to look over the plant, an entire change was made in the lubricants used, and, as a result, a money saving of over $2.25 per day (practically $700 per annum—this in a plant of less than 250-horse power) was affected, notwithstanding the fact that the new lubricants used cost considerably more per gallon than those formerly used. This simply indicates that the *price of an oil is of little importance in comparison with its friction reducing power.* Friction costs money, because it means greater cost of operation per unit of output.

Among the expenses chargeable to waste power, due to inferior lubrication, may be included: 1. The cost of power produced in excess of that really required to operate the mine per ton of output. In this calculation should be included the proper proportion of salaries of engineers, and all other items which contribute to the cost of the motive department, as well as the cost of mining the fuel consumed in producing this excess power. 2. Wear and tear of machinery, which is constantly doing more work per ton of coal mined than should be required of it.

There is also an element of danger, which ought to receive serious consideration, as, while it is true that cylinder and bearing lubricants of indifferent merit will, under ordinary conditions, keep the cylinders from groaning and the bearings from becoming hot, experiments have proven that in accomplishing such results the oils in use were being taxed to their utmost; and there is record of many instances where, as a result of using oils of such limited endurance, accidents of a serious nature have occurred, necessarily causing shut-downs just at the time when the operation of a plant to its fullest capacity was imperative.

It is most difficult, in an article of this character, to do much more than point out the danger due to the use of inferior lubricants, leaving it to the purchaser himself to determine as to the intrinsic worth of the lubricants offered to him. In making his selection, he would do well to consult with, and heed the advice of, some highly responsible manufacturer of lubricants who has given to the question, in all its phases, the most careful study, and who would most probably have the benefit of a wide experience in the application of, as well as the manufacture of, lubricants. Some buyers have, to their ultimate regret, adopted as a method of determining the merits of lubricants, a schedule of laboratory tests. Such a method is not only useless but it is misleading to any one other than a manufacturer of lubricants, who makes use of it merely as a means of insuring uniformity in his manufactured products, and *not* as a *measure whereby to judge their practical value.* Indeed, many oils can be very properly described by practically the same schedule of tests, and yet are widely apart when their utility for a given service is considered.

As a general guide in purchasing cylinder oil for mine lubrication, it might be said that a dark colored oil is of greater value, as a rule, than one that has been filtered to a red or light amber color, as the process of filtration necessarily takes from the oil a considerable percentage of its lubricating value, and, at the same time, the process is an expensive one. In short, if a light colored oil is insisted upon, a high price must be paid for an inferior lubricant. As a word of caution, however, it would be well to add right here that irresponsible manufacturers frequently take advantage of the fact that the most efficient and best known cylinder oils are dark colored, and endeavor, with more or less success, to market as "cylinder oil" products absolutely unsuited for the lubrication of steam cylinders, and which would, consequently, be expensive could they be procured without cost.

The same dark colored cylinder oil as above described should give satisfaction for the lubrication of the cylinders of air compressors and in lubricating steam drills.

For the lubrication of engine bearings, where modern appliances for feeding are used, an engine oil of a free running nature is best, as it more quickly reaches the parts requiring lubrication than an oil of a more sluggish nature. It, of course, must not be an oil susceptible to temperature changes, but must be capable of performing the service required of it under the most severe conditions, where an oil of less "backbone" would fail. Such an oil would also be suitable for the

lubrication of dynamos and all similar rapid running machinery. Where the machinery is of an old type and loose jointed, or when the bearings are open, and the oil is applied directly to them by means of an oiler, an engine oil of a more sluggish, or viscid, nature is best.

Laying Gas and Water Mains in Public and Private Streets.

[A paper read by MR. ARTHUR GRAHAM, of Mansfield, at the last meeting of the Manchester District Institution of Gas Engineers.]

The subject I have the pleasure of introducing to you is one which must be of great interest and importance to us all. I do not think there is any other branch of our business where there are so many different ways as in dealing with this subject.

There are many places that can not see their way to lay gas and water mains unless they have a guaranteed 10 per cent. return before they consider the matter. Now I contend that when we can borrow money at 3 or 3½ per cent., gas and water undertakings ought to be only too pleased to lay on the connections, because they are certain to increase their output before long—especially since slot meters have been adopted—without any guarantee whatever. There are many cases to-day where people would be only too pleased to be consumers, if gas was laid into their streets and houses free of charge, and without the trouble of signing petitions or any guarantee.

Whenever we have an application for laying gas, either up a public or private street, the first question we ask ourselves is. How many consumers are we going to get; and what will be the return on the cost? In many cases, when the matter comes before our respective committees or directors, the same question is asked; and, unless we can show or guarantee them 10 per cent. returns, the application falls through, or must be adjourned, or some other method is to be adopted. For private streets, the owner will be asked to pay a quarter or half the cost, and guarantee a minimum payment of something like $15 per year for five years, or some similar arrangement, on a total cost of about $250; or he must draw up a petition and get all would-be consumers to sign it, and then perhaps they cannot see their way to do it at once.

I quite agree that all cases must be considered on their merits; and we shall find different conditions under many circumstances. But my contentions are that, when we have a street with houses built on one or both sides, it is out of reason to require 10 per cent., or any guarantee, before the work can be put in hand. If we want to increase our business, we cannot do it without extending our mains; and if the cost can only just be covered, it ought to be done. I find that one will soon get consumers to pay 10 per cent. three times over without placing any obstacle in the way whatever. With our slot meters we are giving 25 cubic feet for 2 cents, with the use of a griller, and laying gas into houses free of charge; and during the past two years we have fixed 460 slot meters. We are now fixing a street lamp in yards for every ten houses; and in nearly every case, we have all the houses as slot consumers.

Some 18 months ago I prevailed on our builders to put fittings into houses when building, as I could see before long, when tenants were inquiring after houses, the question would be asked, "Is gas laid on?" They nearly all agreed; and I am pleased to say the question has already been asked several times. Now in these streets, when we find the pipes have been fixed in the houses, we are only too pleased to lay on the supply without delay—either public or private; and have found in nearly every instance that each house had become a consumer. If this course had not been adopted, there is not the slightest doubt that it might have been years before the gas was laid on.

I attribute our rapid development to taking this course, for five years ago we were only making 66 millions, and the present year we shall make 95 millions, or about 44 per cent. increase; and the greater part of this has taken place during the past 2½ years. We have also reduced the price of gas 18 cents per 1,000 cubic feet. Then I say, Why should we hesitate about running a little risk for a short time by laying gas mains in our streets, when there are plenty of houses that would take slot meters, but cannot get them because no one comes forward to promote a petition or guarantee the usual 10 per cent.?

In a case where they are laying out new streets—there being no houses, and gas and water mains are being laid—I do consider it is in order that 10 per cent. should be guaranteed, because one does not know when houses are going to be built. Twelve months ago we laid both gas and water mains in three new streets; and the arrangement we came to was to allow the owner to do his own excavating, the corporation to lay the necessary mains, and the owner to pay 10 per cent. on the mains until there was sufficient property erected to pay the necessary 10 per cent. But this, in my opinion, is an entirely different thing, as there are only three houses being erected at present.

In conclusion, I maintain that a great many consumers may be obtained if only gas undertakings would run a little risk, lay mains and fix services, and give meters free where there are houses. Consumers are certain to come now that so many facilities are given—at least, that has been my experience. My reason for introducing the subject was to hear what my brother managers were doing elsewhere, and to see if any new ideas or improvements could be made in the way of increasing our business.

Discussion.

The President thought the members would generally agree with Mr. Graham's view. The question was whether it was worth while to adopt a pushing and speculative policy rather than adhere to the old "stick in the mud" policy.

Mr. H. Townsend (Wakefield) said, when he first went to his present works, they charged for putting in service pipes on all private property, but the accounts gave a great deal of trouble, and they seemed to set the customers' backs up. So that, as it did not amount to more than $500 per annum in the aggregate, he advised his Directors to abolish it, and to go in for laying mains, and fixing meters and stoves free of cost to the consumer. The result was that they had got every house which had been built since as a customer, whereas previously they had only one in four. He thought this information might be useful to other managers, and would entirely support Mr. Graham.

Mr. H. Kendrick (Stratford) said, with regard to suburban property, there was sometimes a limit to the length of a service pipe. One works with which he had been connected had a limit of 30 feet from the nearest footpath. It was originally from the nearest main, which would mean, in one particular road that he had in his mind, that all the consumers would pay half the cost of the service pipe. So far as fixing meters was concerned, he had seen three works which worked on three different systems. The first was a corporation works, where they fixed them by fitters under their own control; but they charged a lump sum of $1.25 all round. The second works fixed them by their own fitters, and did not charge anything. The third works did not do any fixing at all, but left the consumer to get it done by a local plumber. He should say that it was far better for companies—and he had urged this upon his own people, though he was sorry to say with very poor success so far—to keep all this work in their own hands, and not let the local plumber have anything at all to do with it. The meters were their own property; and the local plumber did not understand the fixing of them. If it were not for the trouble they gave rise to, the mistakes made by the local plumber would be extremely amusing. Although no charge was made to customers in the Manchester district for fixing cookers, it was a mistake to say that they were fixed free of charge, because an increased rental was charged. The extra amount that was charged did not press very hard on the consumer, and did no more than repay the interest to the corporation or gas company. For instance, they had a contract price of $6.25 with the plumbers in the neighborhood for the fixing of any gas cooker; and they got 50 cents a year from the consumer; so that they did not make a large amount on it, considering that they had to cart the cooker out, and bring it back again when it was done away with, at their own expense. Another point that had been brought before District Associations on previous occasions was how far the officials should have control of the gas. Should it end with the meter or the burner? Personally, he had rather strong feelings on this point. He thought gas companies' control should extend to the burner—even going to the extent of distributing free new burners, though he was afraid many consumers would rather look askance at them if they suggested it, for they would want a guarantee that their gas bills would be lessened and not increased. It behoved everyone who had any idea of taking up this work to see how it would affect them personally. Reverting to the first point raised by Mr. Graham, as to what the company should do with regard to laying mains in roads, they would have to take into consideration whether it was in a suburban or urban road. His district happened to be entirely suburban; and his Directors would have to take up the position which Mr. Graham appreciated, of trying to get from the landlord some payment towards the laying of mains. In most cases the roads in his district came under the second category, of being slowly built upon. He thought this was a point that needed more discussion, and should be more thought about than it had been in the past.

Mr. C. Wood (Bradford) quite agreed with Mr. Graham that they should do everything they could to encourage the consumption of gas, and ought not to insist upon having a 10 per cent. return on the cost of

the mains or services in all new districts. Perhaps in Bradford they were fortunately situated in this respect, having a somewhat restricted and well-built-upon area of supply. There were scarcely any householders at all in Bradford who were not consumers of gas. For many years gasfittings had been put in all new property as a matter of course; and, therefore, also quite as a matter of course, they had caused gas to be consumed. They had a rule of charging for an extra length of service over 30 feet on private ground; but this was insisted upon in only a very few instances. They found in the case of suburban houses, where they sometimes had to lay 50 or 60 feet, the return from the gas supplied amply repaid for the extra length. As a rule, they were large houses with long gardens, and there was no difficulty in getting the accounts paid. They had also in Bradford a very good system of collecting the accounts. They were a little backward in one respect—viz., that very few of the meters belonged to the Corporation, the bulk of them being the property of the owners of the houses. The owners were responsible to the Corporation for the gas supplied in the case of cottages rented under $50 a year. They paid in a lump sum, and collected it weekly from the tenants. The owner got an additional discount for this, which he thought repaid him for his trouble. In Bradford, it had been the practice for many years in all new streets (and many old ones) to lay the mains under the footpaths on both sides. This reduced the leakage very much. They had a great deal of granite paving with concrete underneath, so that the mains in the middle of the roads were most difficult to get at in case of leakage. He had known a case where the leakage was more than 100 yards from the place where the gas was first detected. It was also necessary to have some recognized rule as to where mains should be laid—especially in towns where there were gas and water mains, telephone pipes, post office pipes and electric cables in pipes. Only the previous week a curious thing had happened. They had from their works a 5-inch ammoniacal liquor main which went to their chemical works, and the men from the water department had tapped the main, and they might have put the connection to the house if they had not at the opportune moment started sending some liquor through the main at 40 pounds pressure. It was certainly necessary that each department should know where the mains of every other department were situated.

Mr. Townsend wished to add to his previous remarks that, for the protection of the Company, they publicly announced that they laid services free within 25 yards of the main. This gave the Company power to escape any difficulties referred to by Mr. Kendrick. As a matter of fact, they found that it was very seldom the length of a service exceeded 25 yards.

The President said the question raised by Mr. Graham could not fail to be of interest to every manager, because they would all at one time or other have to lay mains. The subject suggested itself differently to different minds. His company were about to promote an Act of Parliament; and the difficulty they had had with regard to private streets had led them to insert a clause authorizing them to lay mains in private streets as they did in public streets. It might sometimes be a question whether they could get the requisite permission to lay the pipes. Mr. Graham's people seemed to have the idea that property owners should pay or guarantee a certain return on the outlay; but he (the President) thought this was becoming more and more out of date every day.

Mr. Graham, in reply to Mr. Kendrick as to drawing the line for laying a service pipe free at 30 feet, said all he could remark was that if there was any doubt whether an intending customer would have the gas if he had to pay for laying the service pipe, he should let him have it free. The cost of 30 feet of pipe was only trifling. As to fixing meters, one company he was connected with charged 37 cents for fixing and 37 cents for changing meters. He thought this so absurd that he changed it. With regard to cookers, they took 25 per cent. off the cost price, which left them 5 per cent. on their purchase. He did not think they could do much in the way of giving the consumers satisfaction with regard to gas burners. He quite agreed with Mr. Wood that it was right to lay the mains on both sides of the road; but this was only in the case of wide ones—it would not do in ordinary streets. He thought it would have a tendency to reduce the leakage, and, of course, they would be able to work at a less pressure. One company he was connected with would not fix meters of more than 5 light size unless they were purchased; but he thought this was altered now that the corporation had bought them up.

The President said he was afraid that Mr. Graham's last sentence might create a wrong impression. It was not always necessary for a corporation to buy up a company in order to bring about an altered policy.

The Education of Machinists, Foremen and Mechanical Engineers.

[Abstracted from a paper read by Mr. M. P. HIGGINS at the last meeting of the American Society of Mechanical Engineers.]

The central object of this paper is to outline a special school for the training of boys to fill the successive grades of mechanics from machinists to engineers, and which shall be adapted to train each boy for each sucecssive grade until his particular career is determined by natural selection and he goes out fitted for that career.

While it must be admitted that during the past 25 years most gratifying progress has been made in American mechanical engineering and in the education of mechanical engineers, yet it is evident to the managers of our mechanical establishments that there is a great lack of competent mechanics below the grade of the mechanical engineer to take the increasing demands and responsibility of the work and properly carry it out.

The standard of the work of the machinist has rapidly moved forward in refinements and complications. He is called upon to read and understand intricate drawings, and to make quickly and with certainty very exact measurements and computations in the shop. He must deal with tempered steel for almost numberless uses and for the severest requirements. Hardened steel parts must be fitted to an extent and with a precision never thought of 25 years ago. This practice of machine construction will be introduced to an unlimited extent in the future, necessarily making many changes in methods, as, for example, the substitution of grinding for filing, which will secure so much better results. This introduces the modern machinist to a field of unlimited possibility requiring most exact knowledge of new and constantly changing methods; and the experience of all employers testifies to the difficulty, if not the impossibility, of securing the requisite knowledge and skill in the machinists of to day.

If the position of machinist is a hard one to fill, what is to be said of that of foreman? At a recent meeting of managers it was stated that 200 young men suitable for foremen for foundries could be placed at once. Nothing is more difficult than to find men capable of filling such positions. Indeed, I have expressed the opinion, and I believe it will be confirmed by others, that the most difficult position to fill when a machine business is to be organized is that of shop foreman. The position of president, treasurer, mechanical engineer, salesman, etc., need not wait a day for applicants; but the man who is fitted to manage the practical details of a machine shop successfully is a rare man, and there is no scientific or professional man whose services are in surer demand than his.

Is it not wise, economical shop management which is giving us the leading position in the machine markets at home and abroad? This is what we expect the good foreman to exhibit. The ability to produce a very fine and exact piece of work in a machine shop, regardless of time or method, will not insure success, but, on the other hand, will be most apt to induce failure. It is the shop which can build the best machinery at a less cost than others which is sure to be successful; and to secure this the management must depend upon no man more than the shop foreman. He must ascertain all possible legitimate ways and means for reducing shop costs, stopping leaks and losses, without reducing the manliness of the men and the standard of the work. How many men of this kind do we get, and what opportunity is there to-day for training for such positions?

With this great and growing demand of the procession, and with the splendid opportunities open to young men who will fit themselves to be mechanics, and who in turn are demanding of the profession the chance to fit themselves, the question is forced to our attention: How are these needs being met?

Never was there a national movement more timely or more successful in its introduction than the movement looking toward the establishment of technical schools 35 years ago in this country, supplemented as it was by the educational land grant act in 1862. We naturally expected at that time that this movement would meet not only the higher education of engineers, but the needs of mechanics, which this paper emphasizes. Perhaps, however, it was too much to expect that these schools, under the management of professional educators, the most able and suitable that could be selected at that time, could have accomplished so much or covered more ground than they have. It is most natural that each technical school management should be greatly influenced by the college education and academic professionalism of the men who conduct it, to whom were entrusted the relations of academic and practical departments and those of theory and practice. This has resulted in a tendency to produce scientists and not mechanics.

It is not the policy and intention of engineering schools to put sufficient time and stress on shop work to allow the student to attain thorough practical skill. He very readily receives the impression that an engineer need not work with his own hands, though he admits that he should know how the work should be done by others. To be a thorough mechanic, which he ought to be before he can be a well-trained mechanical engineer, he must be able to do the work, and this the present technical school does not teach thoroughly.

The gulf between the work of the schools and the shops has sometimes been called a difference between theory and practice; but the real variance in educational attempts is between men, between the mechanic and the schoolman, between the machinist and the engineer. Brave attempts have been made to bring the two together, but with partial success only. In one of our most prominent and practical engineering schools a professor has designed a commutator which required sections cut from a metal ring. The professor ordered two rings, so that a piece from the second could be used to make up for the loss in cutting up the first. The machinist said: "Let me make one ring only, somewhat larger than you want, cut it up, and then turn it to the exact size, and thus save the cost of the second ring." "No," answered the professor, "I am doing the engineering, I want you to do the work." I state this actual occurrence, as one of many illustrations which might be given, to show that the two have not yet joined work even in the technical schools. It is not always an easy matter to secure this necessary union, and even where it seems to be attained it is not always complete. It can be secured by having both vital parts in one and the same man. And it is exactly this union that the proposed system for training mechanics is designed to secure.

The very surprising fact that the total number of students in technical colleges in this country is at present on the decrease, may suggest that some changes in the engineering courses would better meet the needs of a larger class.

This unexpected falling off in the number of engineering students is greater than can be readily accounted for in these prosperous times, amounting to 15 per cent. from 1894 to 1897. These facts were first shown by Dr. Wadsworth, President of the Michigan College of Mines, and since verified by Mr. William Barclay Parsons, Trustee of Columbia University.

I would also mention that with the tendency toward the abstract and scientific which has been referred to, has come the raising of standards for admission from year to year, so that the technical school has become more nearly on a par with the college than it was when it started, and this puts the school beyond the reach of boys who are to make workmen and also beyond the reach of many who would make engineers.

Prof. R. H. Thurston, in a thorough treatise on this subject, says:

In the opinion of many of the ablest and most authoritative members of the profession, the process of raising entrance requirements has already gone too far, and the result of carrying the process further, for purely sentimental reasons which do not appeal to the people who desire to send their sons to such schools, will be seriously to cripple institutions of this kind in the work of aiding the industrial classes.

Thus, whatever the advantages of the technical school and college, which I would not for a moment belittle or decry, they do not meet the needs for which they were founded, but leave the uncovered field as large as ever.

As a result of the technical school overlooking the needs of the large body of mechanics and devoting themselves to the production of scientific professionalists, they produce an enormous amount of discarded material, men who are neither fit for workmen nor engineers, men who are not at the start fit to become successful engineers.

In a class of 100 in an engineering college, if only 5 make engineers such as the course is aimed to produce, the 95 others have not, in all probability, received a course of training well fitted for their special needs and capacities. Further than this, the large portion of the class who are, to some extent, failures are also frequently disappointed men.

There are many reasons why the young man who enters an engineering school is allowed to get false ideas regarding his future. He understands that there is a lively demand in the active world for technically trained young men. He likes the idea of being an "engineer," and he knows that all the leading technical schools have high grade engineering courses, the requirements are up to the colleges, and he expects when he graduates he will be able to engage in engineering work. When he finds that he either cannot do engineering work at all, or that there are ten engineer graduates to one position of that particular kind, and that every year the demand for professional engineers grows less and the graduates more numerous, he turns his attention reluctantly to a lower grade of work, and is never quite satisfied or happy in it. He feels that he was born and educated for something better. But was he? No. He only thought he was. His failure would be no fault of the school, however, if he had not been, in a sense, educated away from the work that he is obliged to undertake. These "culls" from an engineering class are not first-class material for workmen in any department below the engineer. Such a man is a disappointment to himself and to his employer. And though we may be able to show that every graduate in a class has been greatly benefited and developed during the course of study, yet that is not a sufficient reason for a course fitted only to the very few and which allows the large majority to come to their disappointment through the general understanding that, if they were graduated, they would be engineers because they were graduates. Consider, also, what a fearfully expensive system this is, with its large percentage of failures or partial failures, to educate the few of which there is already a larger number than can secure positions as professional engineers.

We must remember that mechanical progress is very dependent upon the capitalist. The proprietor who stands behind the work is more and more inclined to trust his engineering to his own men who have grown up in the works and have, in some way or other, picked up science enough to get on with considerable success. The proprietor is not inclined to put his work into the hands of a professional engineer who works on the same problem for other clients, and he is less and less inclined to employ special engineers. When this is done at all, one engineer is employed by several concerns, and his time divided up among them.

This lessened demand for polytechnic graduates was recognized several years ago in Europe, and some slight attempts were made to remedy the evil. As early as 1885 the British Commissioners found in Germany an excess over the demand of 1,000 well-trained polytechnic graduates, and they were informed that the manager of a large engineering works had been so importuned by these young men for employment that he put a notice in his window: "No polytechnic student need apply." The Baron von Eybesfeld, Austrian Minister of Instruction, stated that the most serious problem in education in that country is to reduce the number of theoretical engineers (who, after their long course of study, find themselves not wanted) and to increase the number of men in whose training theory and practice had been so combined that they could meet the great demand for those who can put theory and practice together. This statement, taken from a report of "Technical Instruction in Europe," by the late C. O. Thompson, formerly President of the Rose Polytechnic Institute, and published by the United States Bureau of Education, is followed by another statement which shows that the tendency of the technical schools toward a par with the college, referred to above, was fully recognized and admitted at that time. This statement says:

There is a constant and apparently irresistible tendency in all the lower schools to pass up into the higher by imperceptible advances. For example, at Chemnitz what used to be the Gewerbeschule has ranked since 1879 as a polytechnic school. But so true is it that a school of higher education never loses or departs from the cast it receives in the first ten years of its existence, that the old polytechnics, modeled largely after the Ecole Polytechnique of Paris, have so steadily held to the theoretical training of engineers that the times have swept past them. The efforts now making in Austria to remedy this evil are more to the point than any others of Europe, but they are directed towards the artisan rather than the engineer.

As a single instance from many that might be cited illustrating the tendency of technical schools in America as well as in Europe to drift more and more out of the reach of the boy who wishes to educate himself as a mechanic, I refer to the history of the Worcester Polytechnic Institute. In 1884 the full course for a mechanical engineer was 3½ years. In 1896 it was 4 years. In 1884 the shop practice for the 3½ years' course was 2,376 hours. In 1896, even with the 4 years' course, the shop practice was only 1,709 hours, a reduction of over 28 per cent., and an increase of time and consequent expense to the student of 14 per cent. In 1884 a year's school work consisted of 42 weeks. In 1896 there were only 36 weeks, a loss of time of 14 per cent. The productive activity of the school shops has been reduced from $109,027.78 in 1896 to only $20,801.82 in 1898.

Since 1889 the tuition has been raised from $100 to $150—an increase of 50 per cent. In 1873 this institution was able to advertise that the total expenses of a member of the school, including tuition, utensils and board, need not exceed $380 per year. The present advertised estimate is $450 per year—an increase of over 19 per cent.

The proposed solution of the problem lies in the answer to the ques-

tion, "How can we give our boys a chance to learn a trade without being deprived of a good common school education, and at the same time secure a foundation upon which to build a higher education, if capcity and circumstances permit?"

The half-time school, established upon the plan outlined below, will, it is believed, answer this question and solve the problem.

This school is aimed to fit each boy for the successive grades of mechanics from the machinist up, so that at any time he will be fitted to take up his work outside as a well trained mechanic in the grade which he has completed, and be prepared to enter the training of the next grade. In other words, the object of the school is to produce many well trained and educated machinists, and from these machinists some foremen, from the foremen a few superintendents, and finally an occasional engineer. The character of the individual material in ability and natural aptitude determines the grade of the product of the school, whether workman, foremen, superintendent or engineer. The plan will be understood by a brief statement of its prominent features:

1. A school which shall include a first class commercially successful and productive machine shop, which is a department co-ordinate in importance, influence and educational value with the academic department.

2. A school in which the pupils are to have instruction and practice in this shop during half the working hours in five days of each week for a period of four years.

3. Instruction in the public schools during a portion of the other half of the time, equivalent to a high school course, restricted, abridged and improved to meet the needs of these pupils.

4. Special care and method of selection of pupils who have finished the grammar school course and who have special aptness for mechanical work.

5. Management under a corporation whose trustees shall be practical business men.

We can confidently assure a more thorough expert knowledge of the machinist's trade, and a more practical skill in its various departments, than is generally secured by any apprenticeship in this country or Europe. This rather large expectation is based upon quite a thorough personal study of what is accomplished in England, France, Switzerland and Germany, and also upon what has been accomplished during 28 years at the Washburn shops of the Polytechnic Institute of Worcester, Mass.

In this school, where a 3½ years' course included only 2,376 hours of shop practice, or, in other words, less than one-third of a 3-years' apprenticeship, the graduates have always enjoyed a high reputation for practical skill and shop experience. And it has been claimed through out the history of the school that its graduates are as skilful and effect ive practical machinists as those who have served a 3-years' apprenticeship to learn the machinist's trade. This is a very bold claim, when it is remembered that together with this attainment of practical skill the graduate has obtained a thorough technical and scientific education. After a very thorough experience and after employing large numbers of these graduates in all capacities in machine shops, I think the claim is well sustained.

In the half-time school actual shop practice in the various departments would cover a much longer time, and under circumstances more favorable, because the attainment of a thorough machinist's trade is confessedly the central point from which the future engineering work is to emanate.

2. These pupils will receive, as a part of their shop practice, a much larger amount of time in lectures and instruction upon the technical part of the machinist's business than is given in the technical school.

3. It is proposed to train every pupil in the general knowledge and practice of drawing and machine design, and anyone having particular taste in this direction can have special and advanced instruction, the object being to make draftsmen superior to engineering school graduates in the following particulars:

(a) More expert in execution of drawing and lettering.

(b) Much more thoroughly familiar with all the shop knowledge affecting the efficiency of a draftsman on simple everyday work.

(c) A more ready, reliable and precise use of arithmetic.

4. It is proposed to train every pupil in a general knowledge and practice of pattern making and foundry molding, and in special cases give advanced instruction and practice in pattern making. In all cases, however, the machinist's trade will be taught as the basis of any special line of mechanical work.

5. Pupils who exhibit suitable qualifications as workmen and as directors of men, will have special opportunities to become fitted for responsible positions, as working machine shop foremen. Such pupils, among other qualifications necessary for foremen, would be required to show general ability in drawing, pattern making and special accuracy and reliability in arithmetic.

6. If anyone from the above mentioned classes of men exhibits taste and natural abilities for high grade engineering work, requiring the highest mathematical and scientific knowledge, he will be encouraged and aided to take a course to meet his special requirements in an engineering school.

Do we get the best stock for engineers? We have the sons of engineers who stand first in the great industrial enterprises. The young men coming to the engineering schools are generally the best in many ways. They are usually well born; they do not often come from poor homes, where work, stern effort and self denial keep boys out of reach of the thorough systematic mental training which fits them for entrance examinations. If such a boy from the poor home finds it possible to enter, the college life is rather out of his line and out of his reach, and the funds for the term bills are still more impossible. But in this class are many who should be fitted for the different grades of mechanics.

It is well to remember, in the light of all history, that the revolutions of fate bring the submerged to the top, and after a while the child of fortune becomes enervated by advantageous ease and good keeping, and frequently the son, in spite of the father's determination to give him a better chance than he had, lacks something which has distinguished the father, and we may, after all, search this class in vain for the best stuff for engineers. It cannot, however, be the wisest educational scheme which allows the rich man's boy to degenerate, or merit to go undiscovered in the poorer classes, wherever it may exist.

There are marvelous possibilities of skill and invention among a class of boys who are never thought of as possible engineers, boys who sometimes make themselves leaders among the favored ones of the earth. In one of the largest and most prosperous industries nearby I find that the man who knows the most about a very important department carried a hod when the factory was building ten years ago; and the responsible head of another department was "snagging" castings eight years ago. One of the fond hopes of the half time school is that it will pan out the pure metal by a sifting process which is true and fair; and selection of material is the first important step in the process. The selection of the pupils is only second in importance to the schooling itself.

The proper education of the American mechanic will not necessarily be sought after by the boy who is best capable to become the mechanic. He must be sought out and then trained. The American boy needs to be awakened to the inducements for becoming an educated mechanic. Many a boy who is splendidly suited by nature and by inheritance to this calling is allowed by outside influences to drift into some other calling to which he is not adapted, all for the lack of a little guidance or some circumstance having no connection with his fitness or aptitude for mechanics, and thus is lost to the profession which needs him.

The hindrance to the best results in engineering schools, which has come from the imperfect and unfair method of selection in making up or enlisting its classes, has already been mentioned. Under the present system it is a boy's business to spend several years of cramming for examinations after he decides upon going to a polytechnic school or college. His whole aim with the aim of his teacher is to prepare for the examinations. The fitting school develops an astonishing ability to pass examinations which are not a true or adequate test of a boy's fitness to make a mechanic or a mechanical engineer. Therefore the entering class of the polytechnic institute consists of a body of experts at examinations, while the boys all through the country who ought to be trained for manufacturing and mechanical industry are overlooked and passed by.

There is a great opportunity for improvement in the education of the boy offered by a radical change in the matter of vacations. The present method is to crowd the work of the week into five days, and the work of the year into 35 or 37 weeks, making it as intense as possible for awhile and then letting up entirely.

It is certainly not impossible to arrange a course of education and training of a boy with hard work so judiciously distributed and so interspersed with healthful, easy and enjoyable exercises and so intermingled with daily (not quarterly or yearly) recreation, that he will never need or require entire or complete relief from duty. Nothing is so dangerous or so trying to a boy's nervous, mental and physical constitution as the method of suddenly applied load and long intervals of total relief. Six days' work in a week, with sufficient variety recreation, and healthful exercise distributed throughout each day, and with Sunday properly spent, will, I think, assure much better and more enjoyable effort on each following Monday than is possible where all the students' work is dropped for two days every week.

The same gain may be obtained by distributing the work throughout the 11 or 12 months of the year. I must not be understood as recommending harder or more work. I would make an easier course for boys, not a harder one, by having a better arrangement and distribution of an ample amount of daily work, rest and recreation, and then, instead of the present vacation, which is frequently harmful instead of helpful, I would grant furloughs to any student who needed or desired it. Such furloughs are not impossible or impracticable, and would be, in my judgment, much better and more effective than the present vacation seasons. Let it be understood that this presupposes a school organized for the good of the pupils and not for the convenience of the teachers.

It seems to me that this danger is very great, a danger that has already been realized, from time to time, in almost every institution of learning. Many methods have been resorted to to avert the danger, such as shortening terms of study, which necessarily make them more condensed, the introduction of athletics, etc., which is apt to absorb enthusiasm needed for the work; and when I have suggested continuous school work, less vacations and less interruptions, I insist that I do not believe in harder work but easier work for students, and I believe that a 4 years' course can be so arranged, with such interesting and profitable variety of occupation alternating between the recitation room, the drafting room, the pattern making room, the machine shop, the shop lecture room, and with the requisite amount of exercise and recreation, not at long intervals, but in every half day, that a boy's life from 15 to 19 would be a joy and not a burden.

America has made a strong beginning as an export nation of high grade machinery. There are many evidences of the keen interest, amounting to surprise and alarm, on the part of our Europe rivals. It is interesting to note their efforts to discover the causes of this sudden uprising of a new and evidently powerful rival in a field heretofore all their own.

The cause of our supremacy has not been altogether the superiority of our engineers, for foreign nations also have highly educated engineers. But it has largely resulted from the superior character and make up of our mechanics, which has come from the chance which America gives the workman, and in the liberal and wise provisions to train free born American boys, giving each a fair field and open path to rise from one plane to a higher one, as his abilities and circumstances may warrant.

We must not allow ourselves to rest secure in the belief that our Old World competitors will be slow to discern this cause or slow to profit by the example. Therefore, what more potent steps can we take for our protection than to keep this path open from the bottom and to better our methods all the way up through the successive steps?

The Combustibility of Coals.

By Mr. O. Lang, in *Gluckauf*.

This subject has been largely treated by Professor Fischer, of Gottingen, not only at the general meeting of the German Chemical Society of Konigshutte, but also in the "Zeitschrift fur Angewandte Chemie." The conclusions arrived at may prove acceptable.

Spontaneous combustion has long been known in connection with many organic substances besides coal; and, in addition to the vessels lost through this cause recorded by the British Commission of 1877, statistics collected by the German "Spediteur und Rhedereizeitung" show that, of the 155 coal laden vessels lost between 1889 and 1896, 40 were burnt and 30 left no trace.

Thorough investigation soon established the fact that various descriptions of coal behave very differently in this respect, and also that a great deal depends upon the size of the pieces as well as upon dampness. A loss during storage and the self ignition of coal are nothing more than manifestations of oxidation; but great differences of opinion have existed and still exist as regards the influence of iron pyrites and its affinities when found in coal. For separating the sulphur contained in organic combinations in coal from that of the sulphide, great reliance is placed in bromine; but its action cannot be depended upon, because the coal contains variable quantities of unsaturated combinations which store up bromine, and also combinations in which bromine replaces a portion of the hydrogen. While bromine acts upon the coal, a portion of the organically combined sulphur can also be separated as sulphuric acid; and again it is not impossible that a portion of the sulphuric acid formed is again absorbed by the coal.

As regards the various behavior of different coals in the presence of atmospheric oxygen, it is not their elementary composition, nor the so-called excess of hydrogen, which exerts its influence, but the nature and proportion of the various particles in combination with coal.

Coals which rapidly absorb oxygen, and therefore those that have a tendency to spontaneous combustion, will also quickly take up a great deal of bromine. If this tendency be generally verified by further experiments with the most various kinds of coal, one will be in a position to ascertain in a few minutes—and this point is emphasized by the author—whether a given coal is specially inclined to loss through storage and also to spontaneous combustion.

The important test proposed by Fischer as a provisional measure, for vessels to be loaded with coal the properties of which are not known, is the following: 1 gramme ($\frac{1}{35}$ ounce) of the coal sample, finely powdered, is to be mixed with 20 cubic centimeters (1.22 cubic inch) of diluted muriatic acid and then 5 cubic centimeters (0.3 cubic inch), added four times consecutively to a "half normal potassium bromide solution" with frequent shaking; and if now bromide, distinguished by its color and smell, be set free, the coal may be regarded as free from danger, the exact limit, however, being only determinable by very numerous experiments with the most various kinds of coal. The "half normal" solution of bromide and bromate of potassium develops with sulphuric acid for 1 cubic centimeter (0.06 cubic inch), 40 milligrammes (0.617 grain) of bromine according to the equation—

$$5PBr + PBrO_3 + 6HCl = 6PCl + 3H_2O + 3B_2.$$

The results are summed up as follows: Coals contain larger or smaller quantities of unsaturated combinations which eagerly absorb oxygen, thereby increasing in weight but losing in combustibility and cokability; and the more quickly this absorption of oxygen takes place, so much the more must care be taken when storing the coal that the heat set up be correspondingly taken off, because with rising temperature the speed of oxidation greatly increases, and also the danger of spontaneous combustion.

A second series of combinations contained in coals also absorbs oxygen, but with separation of the carbonic acid and water; and this process of oxidation is effected more slowly than that previously mentioned, while diminishing the weight and value of the coal, so that as regards self-ignition these coal constituents are of far less importance than any unsaturated compounds.

According to the proportion of the quantities in which both combinations take place, a coal may, on being stored in the open air, increase in weight, remain unchanged, or lose, while at the same time its value will always diminish more or less; but with large coal stored dry in a cool place this loss will generally be inconsiderable.

Dampness favors ignition, especially if damp, small coal be covered with other coal to the height of 6 or 7 metres (mean 20 feet), as has been repeatedly observed. For instance, several cases of spontaneous combustion occurred in the coal-bins of the Gottingen gas works every time that, on account of a damaged roof, the coal stored to the above named height became wetted through, while when the roof was made tight, and the coal not stored to a greater height than 5 m. (16 feet), no further case of self-ignition occurred.

Some descriptions of coal take up oxygen rather more slowly, but others again more quickly, in damp air, and this even to a greater extent when in a wetted condition, because in that case the oxygen acts in the form of a watery solution upon the unsaturated combinations. Even the oxidation of the combined iron pyrites is greatly favored by wetting the coal, so that in wet coals pyrites can very readily favor spontaneous combustion, although this is not likely to take place with dry coals. Moreover, as organically combined sulphur is not especially inclined to oxidation, the influence of sulphide or of sulphur upon the self ignition of coals is generally over estimated.

As is well known, for the ignition of all combustible substances, including the coals, it is necessary that they be brought to the ignition temperature in the presence of oxygen; and, therefore, so much air is led through stocked coal that the heat generated by the oxidation is taken off, so in this manner the raising of the coal to the ignition temperature is avoided, such ventilation preventing self-ignition. Inasmuch, however, as this cannot be practically brought about, the artificial ventilation of stocked coal is a critical matter, as it often distinctly favors spontaneous combustion; and the safest means for preventing this would be the complete exclusion of oxygen, which, however, is unfortunately not possible except in very rare cases. It is, therefore, especially important to prevent a heating of the coal that coals should be dried and protected from rain, sunshine and other sources of heat, while not being stacked to too great heights.

It is evident, however, concludes Herr Lang, that sufficient light has not yet been thrown upon this question, but that there still remain a great many important points to be cleared up, and Professor Fischer regrets that the chemistry of coal has been scientifically dealt with to so slight an extent, even in Germany, which country produces coal to the value of 700 or 800 million marks (mean $187,500,000) per annum; Much's Steinkohlenchemie standing too much alone. He announces, however, that investigations are already in progress, with comprehensive experiments in connection with oxidized, bromurized, etc., coals, for determining more exactly the constituents to which the behavior of coals in air, their cokability, yield in gas, etc., must be ascribed. In his opinion, however, it depends, so far as practice is concerned, very much upon a knowledge of the behavior for the time being of the oxydizing process that detracts from the value of coal whether such process occasions the same amount of injury in equal periods of time, or whether it becomes considerably reduced after exerting its influence for a certain period, and again whether, and why, it is only in case of need that coal is taken from stock after the chief period of deterioration is passed and the coal has only retained its form.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. H. W. TYLER, Secretary of the Massachusetts Institute of Technology, writing under date of the 6th inst., informs us that the Institute has recently been in receipt of a gift, amounting to $50,000, from Mr. Augustus Lowell, who directs that it is to serve as the nucleus of a fund, the income of which shall be used for the benefit and advantage of the teaching staff of the Institute, in cases of illness, death or retirement, subject to such regulations as the government of the Institute may from time to time direct. In construing the deed of the gift Secretary Tyler says: "It is not apparently the wish of the donor, nor would it harmonize with the practice of the Institute in its general policy in the matter of appointments, that any hard-and-fast scheme of pensioning at a certain age should be inaugurated, even were there sufficient endowment available for that purpose."

MR. GEORGE W. BECK, formerly in charge of the plant of the Canisteo (N. Y.) Gas Company, has been appointed Superintendent of the Company at Sunbury, Pa.

MR. H. W. BURKHART is now in charge of the works of the Hollister (Cal.) Light and Power Company. His appointment dates from the 1st inst.

MESSRS. P. B. Shaw, Henry Metzger, Godfrey Heff and L. M. Garrison have incorporated the United Water, Gas and Electric Company, to transact business in Williamsport, Pa. It is capitalized in $500,000.

A CORRESPONDENT incloses the following clipping, from the Baltimore (Md.) *News*, of recent date: "The price of gas has been reduced, from $1.25 per 1,000 cubic feet, to 75 cents, but the Consolidated Gas Company will not recognize the reduction. The police and detectives of Baltimore are looking for the man who made the reduction, and if he is apprehended he will have to answer at least four charges of obtaining money under false pretences: From August Muhler, grocer, 22 North Eden street, he secured $2.25; from Isaac Flura, 41 Lloyd street, $2.25; from Charley Jun Lee, 904 East Fayette street, $1.50; and from Quong Hing Lung, 303 Hanover street, $2.75. In each case the unknown represented himself as agent for the Consolidated Gas Company and called immediately after the last monthly bill had been left by the regular agent. He represented that the Company needed money for Christmas presents and various other purposes, and said that if the bills were paid at once the price would be reduced to 75 cents per 1,000 cubic feet. The victims fell over themselves in their haste to secure advantage of the reduced rates, and unanimously invited the 'agent' to call again next month with another bargain. He won't call, however. In the case of Charley Jun Lee the bogus agent gave the greatest bargain ever heard of in the history of gas companies. He assured Lee that all the talk about the gas people being monopolists and grabbers was all nonsense, and to prove it he made Lee the stock offer Lee, however, was slow to take it, and the 'agent' then told him that the Gas Company, being very anxious to please him of all consumers, would cut his bill from $5.75 to $1.50, provided he paid right away. Lee took the offer and received in exchange for his money the following unique receipt, written on a blank check: 'Pay to the order of Charley Jun Lee, $1.50. Signed.' The signature was a rubber stamp monogram, 'L. F. B.' On one of the receipts the 'agent' signed a name that looked like 'E. E. S. Knowey,' although it was difficult to decipher. As a rule, he used the stamp, and used it generously. On a bogus meter check he stamped his monogram all over the figures, and made a little border of signatures to impress his victim. His victim was duly impressed."

THE American Investment Company has arranged by purchase for the consolidation of the gas and electric lighting interests of Mount Holly, N. J.

THE reorganization and consolidation of the gas, electric lighting and street railway interests of Anniston, Ala., were completed early this month. The succeeding corporation is to be known as the Anniston Electric and Gas Company, and its Manager is Mr. Howard W. Sexton, who is thoroughly familiar with the state of the separate properties that go to make the merged enterprise.

MR. JAMES D. WALKER, some years ago prominent in the management of the San Francisco Gas Company, died at his home in Shalden, Devonshire, England, on the 11th ult. He was in his 74th year.

MR. F. H. HESS, formerly Superintendent of the Mount Clemens (Mich.) Gas Company, has been appointed Manager of the Benton Harbor-St. Joseph (Mich.) Gas Company.

MR. W. E. CRANSTON succeeds Mr. Hess in the Superintendency of the Mount Clemens works.

IN the JOURNAL for the 4th inst. we said that Mr. F. H. Shelton, of Philadelphia, and Mr. R. D. Apperson, of Staunton, Va., were concerned with an opposition gas movement for Lynchburg, Va. We are more than satisfied to know that our first advices were incorrect, for we have since learned that the franchise asked for by the gentlemen named is in reality a new franchise for the old company, under which the powers of the latter may be enlarged or extended. Messrs. Shelton, Apperson and their associates have purchased outright all the stock heretofore owned by the proprietors of the Lynchburg Gas Light Company.

L. F. CORLISS, of Brooklyn, N. Y., is informed that the last dividend by the Pacific Gas Improvement Company, of San Francisco, Cal., was made payable the 11th inst.

THE Moorestown (N. J.) Gas Company, capitalized in $15,000, has been incorporated for the purpose of supplying gas in the place named, on lighting, heating and power account. Its officers are: President, Joseph T. Sullivan; Vice-President, George W. Heaton; Secretary and Treasurer, Maitland F. Griggs.

MR. JAMES H. THROOP has been oppointed General Manager of the Norwich (N. Y.) Gas and Electric Company.

AT the election held in Davenport, Iowa, early this month, to determine whether or not a franchise permitting the Peoples Light Company to construct and operate a gas works in that city should be adopted, the vote was largely in favor of the proposition.

A correspondent, writing from Bath, Maine, under date of the 12th inst., says that Messrs. Arthur Sewall, George Fisher and others have appealed to the first mortgage bond holders of the Bath Gas and Electric Company for an examination of its affairs. They allege that the assignees of the Company refuse to give a statement of the Company's business standing, and further claim that the assignees are operating the plant to the detriment of those financially interested therein.

THE following is from the Philadelphia *Press*, dated the 9th inst: "The battle royal in the Bay State Gas Company litigation took place yesterday before Judge Dallas in the United States Circuit Court. The matter was brought to the court to determine the materiality and relevancy of the question put to William H. Miller, the Secretary and Treasurer of the Company, at the hearing before the examiners in the case. The question was asked in the suit of Jacob Edwards and others against the Bay State Gas Company, of Delaware, and J. Edward Addicks and others; and by advice of counsel Mr. Miller refused to answer this question before the examiners: 'Will you please give to the court in detail the assets, property and investments of the defendant corporation, as of the 1st day of November, 1893?' On the surface the question is a simple and plain one, but it is said that the answer to it will go to the very heart of the important Bay State Gas Company litigation. At the hearing many of the legal lights of New York, Boston and Philadelphia took part. After an argument lasting several hours the two sides handed up briefs and the Judge reserved his decision. The suit is for an accounting by stock and bondholders entitled to share in the net profits of the defendant Company if there be any. If the complainants are successful in proving their case they will be entitled to a decree directing an accounting by the defendant Company, but until they have such a decree it is contended for the defendant Company that a knowledge in detail of the assets, property, investments, income, expenses, etc., cannot be obtained by them over the objection of the defendants."

MR. JOHN J. KNIGHT, Manager of the Kalamazoo (Mich.) Gas Light Company, is authority for this statement, which was recently made to a reporter of the Kalamazoo *Telegraph*: "The Gas Company is preparing to make very large extensions during the coming year, both in its works and to its main system. We have now engineers at work planning for a new side track, new coal storage sheds, proper weighing apparatus and other betterments. The scheme includes the erection of a meter house and the placing therein of a suitable station meter. We have also various petitions in our office for the extension of mains, particularly on what is known as the East Side." Mr. Knight went on to say that the proposed main extension would include the placing of not less than 5 miles of pipe, and that before the expenditure on all accounts was at an end not less than $50,000 would have been invested.

THE local authorities of Poughkeepsie, N. Y., have authorized the Poughkeepsie Gas Company to light the public buildings for another year. The rate agreed on is $1.50 per 1,000 cubic feet.

(*Continued on page* 979.)

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
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CHAS. E. SANDERSON,
MANAGER.

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MONDAY, DEC. 18, 1899.

(*Continued from page* 978.)

WE understand that Philadelphia capitalists have made a good, round bid for the franchise and properties of the Consumers Gas Company, of Woodbury, N. J.

A CORRESPONDENT in Little Rock, Ark., forwards the following: "Some days ago the Topeka Federal Light, Heat and Power Company filed articles of incorporation. According to the recital the Company proposes: 'The manufacturing and vending of gas and electric currents, and the distributing and delivering of same for any and all purposes for which they can be used in the city of Topeka and its suburbs. The manufacturing, producing, buying, selling, distributing, delivering and utilizing of all forms of products that enter into the manufacture, distribution and use of gas and electric currents.' The directors of the concern are: John A. Kleinhaus, John Martin, M. Snattinger, W. C. Stephenson, G. B. Payne, Jas. M. Padgett, L. F. Randolph and F. White."

MR. E. C. MONROE, who wants (?) to supply gas in Auburn, N. Y., has asked the City Council of that place to "extend for two years" the franchise that he is said to possess. By the time that Mr. Dunning and his associates of the Auburn Gas Light Company get through with Mr. Monroe and his backers the latter will have reason to believe that Auburn is not a good place for the exercise of their peculiar talents.

THE main system of the Media (Pa.) Gas Company is being extended and reinforced.

IT is proposed, through the agency of the recently incorporated Ohio and Indiana Consolidated Natural and Illuminating Company, to consolidate the interests and properties of the Indiana Natural and Illuminating Gas Company, the Logansport and Wabash Valley Gas Company, the Fort Wayne Gas Company, the Lafayette Gas Company and the Ohio and Indiana Gas Company. The capital stock of the succeeding Company is put at $10,000,000. The Directors of the concern, in their notification to the shareholders of the separate Companies over the proposed merging, among other things, say: "The Directors notice with regret that recently there has appeared to be a feeling of alarm among the security holders in all of the five Companies, as evidenced by more frequent transfers of stock and the declining prices of both bonds and stock. The Directors, holding more than 30 per cent. of the capital stock, feel that this alarm is uncalled for. Exaggerated reports of soon expected failure of natural gas have caused this uneasiness. That the 'rock pressure' is continually decreasing is true; but volume remains even in the present fields. How long this will continue no one knows; as impossible to determine now as eight or ten years ago. Meanwhile it will cost each year more and more to continue the present volume of gas, because of greater distances from the source of supply to points of consumption; and, also, because the greater number of wells required, and the additional cost of pumping station, first to build, then to maintain, to take the place of the natural rock pressure, which, as is stated, is diminishing. This increased cost, will, we are sure, be cheerfully borne by the intelligent communities using our gas; and they will, ultimately, grant us the right in all the cities and towns (we already have this concession in some), to use meters, charging for gas a fixed price, and thus obviating waste. This is in the interest of the communities themselves, as much as in the interest of the Companies supplying their needs. No one knows better than they do that their continued prosperity depends upon the permanence of the supply of natural gas. This winter, and probably every winter, there will be reports of failure of natural gas. Do not be unnecessarily disturbed thereby. This has always occurred, and always will occur in extremely cold weather, everyone then demanding greater amounts, while the supply cannot be suddenly increased. This is true of your coal furnaces, and heat furnished by steam companies in extremely cold weather; but, with the cessation of low temperature the trouble passes away." The Committee in charge of the reorganization is appended: Chas. F. Dieterich, A. N. Brady, Geo. C. Clark, A. B. Proal, James H. Benedict and J. Bertschmann.

The Market for Gas Securities.

The general stock market was quite at the panic point this week. The net results, so far as city gas shares are concerned, are about like this: Consolidated may be returned at 180 on the low side, with a recovery to-day (Friday) to 183½—at the close of the market 183¼ was bid for it, holders asking 184½. Standard common was 102 for the low and 106½ for the high—current quotations for it are 105 to 108. This stock is very cheap. New Amsterdam common is gradually getting to its hydraulic level; 20½ was bid for it, and holders asked only a point more. Mutual is strong, as it should be. In fact, if common sense prevailed just now in local gas circles, all of the shares would be strong. However, anything outside of New Amsterdams seem good purchases at current prices.

Brooklyn Union wavers some, but it is undoubtedly cheap at 137. Peoples, of Chicago, sharing in the general depression, is returned at 106 to 107. It should be considered cheap at 125. Bay State is little heard from, despite the litigation that is in progress. Laclede common is off to 78. San Francisco Gas and Electric continues fairly firm. Respecting this Company we have the satisfaction of saying that all rumors regarding differences between President Crockett and his Directors are nothing more than vapors.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

DEC. 18.

☞ All communications will receive particular attention

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$39,078,000	100	183¾	184
Central Union, Bonds, 5's.	3,000,000	1,000	107½	108½
Equitable Bonds, 6's	1,000,000	1,000	108	..
" 1st Con. 5's	2,300,000	1,000	115	18
Metropolitan Bonds	658,000	.	108	112
Mutual	3,590,000	100	300	330
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.	13,000,000	100	20½	21½
Preferred	10,000,000	100	44	46
Bonds, 5's	11,000,000	1,000	92	93
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000		112	114
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	105	108
Preferred	5,000,000	100	135	..
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	135	138
" " Bonds (5's)	15 000,000	1,000	116	119
Bay State	50,000,000	50	1⅝	1⅝
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	40	..
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	68	71
Buffalo City Gas Co.	5,500,000	100	9	11
" " Bonds, 5's	5,250,000	1,000	84	85
Central, San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000	106	108
Columbus (O.) Gas Lt. & Heating Co	1,682,780	100	60	65
Preferred	3,026,500	100	84	86
Consumers. Jersey City Bonds	600,090	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	197	197¼
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		
Consolidated, Baltimore	11,000,000	100	51¾	51⅞
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	21	23
" Con. Mtg. 5's	380,000	1,000	87	90
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,560,000	50	97	98
" Prior Lien 5's	4,598,000	1,000	99½	100
Detroit Gas Co., 5's	386,000	1,000	100	101
" Inc. 5's	16,000	100	100½	101
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	77	83
" Bonds	2,000,000	..	80	85
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	.
Hartford	750,000	25	..	220
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	102	105
Indianapolis	2,000,000	..	122	128
" Bonds, 6's	2 650,000	..	105	106
Jackson Gas Co	250,000	50	72	78
" 1st Mtg. 5's	250,000	1,000	101	102½
Lafayette Gas Co., Ind.	1,000,000	100	68	70
Bonds	1,000,000	1,000	81	86
Louisville	2,570,000	50	106	108
Laclede, St. Louis	7,500,000	100	78	78½
Preferred	2,500,000	100	96	100
Bonds	10,000,000	1,000	107	108
Madison Gas & Elec. Co.	400,000	100	82	85
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co	16,000,000	..	50	60
Bonds, 6's	4,600,000	..	107	108
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	43	45
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	107½	108
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111⅜	111½x
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	55	57
St. Paul Gas Light Co.	1,500,000	100	57½	58½
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	88	90½
St. Joseph Gas Co	1,000,000	100	42	44
" 1st Mtg. 5's	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100	15½	18
Bonds	1,612 000	1,000	81	84
Washington, D. C	2,600,000	20	285	..
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	106¾	107¾
Bonds, 5's	3,880,500	.	106	108
Wilmington, Del.	600,000		220	50

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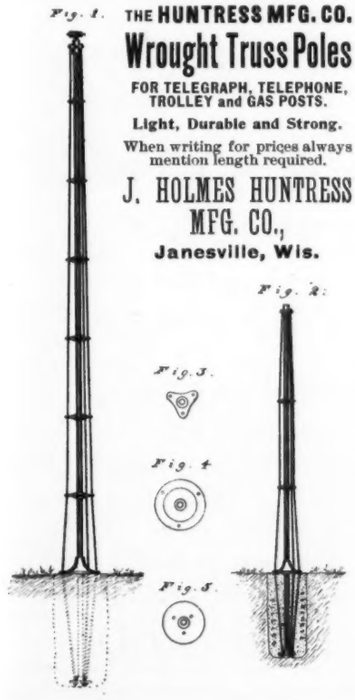

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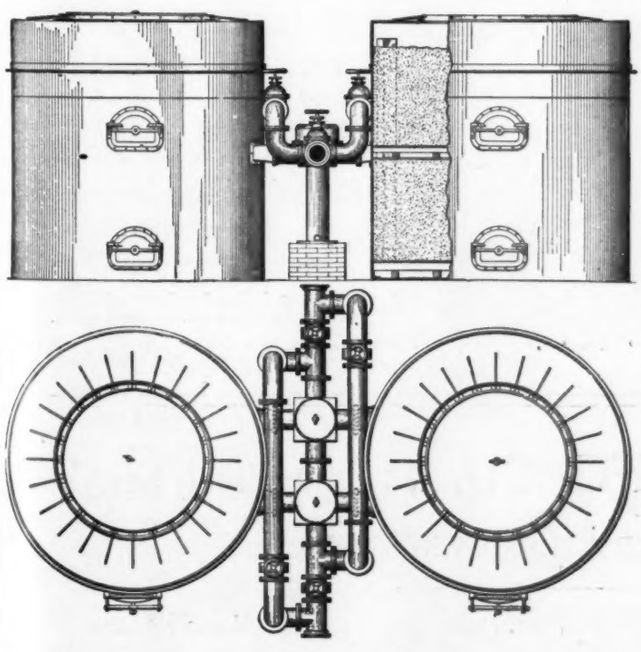

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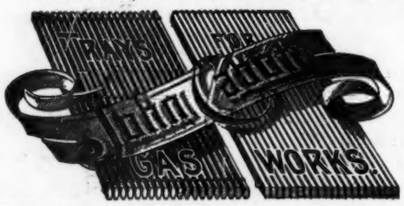

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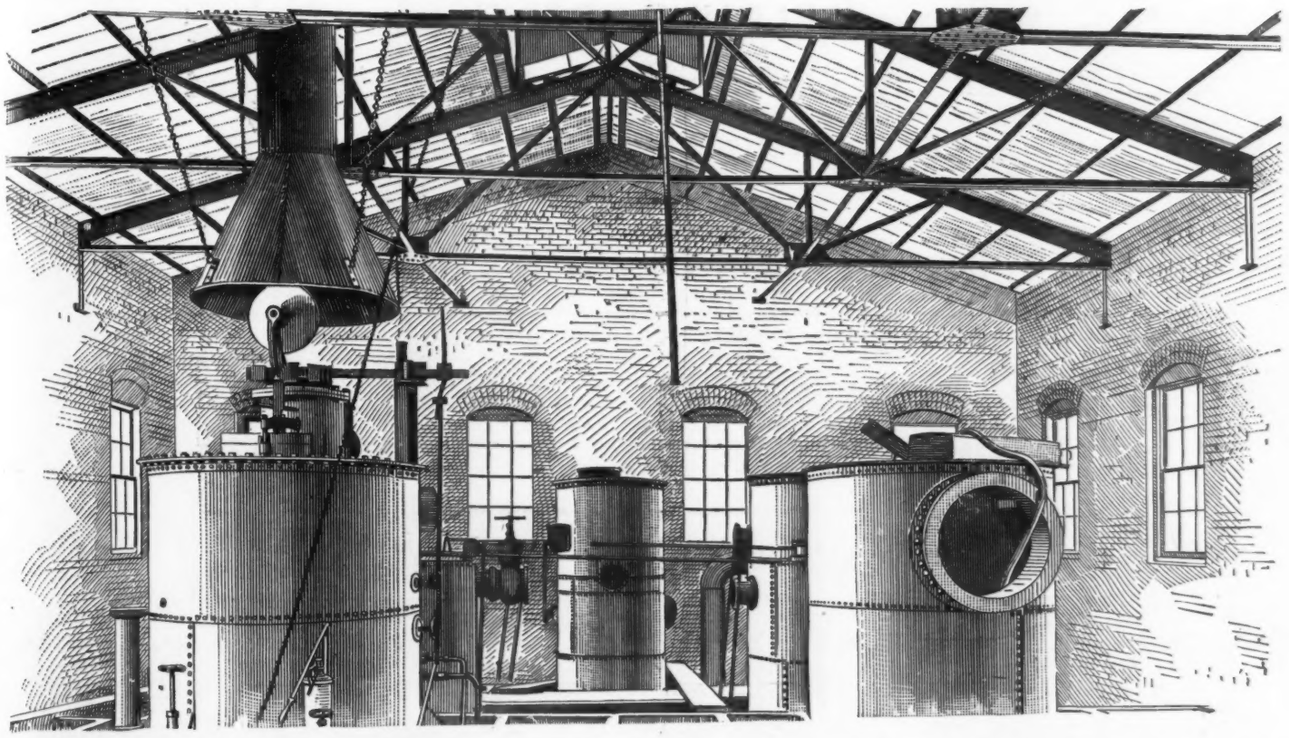

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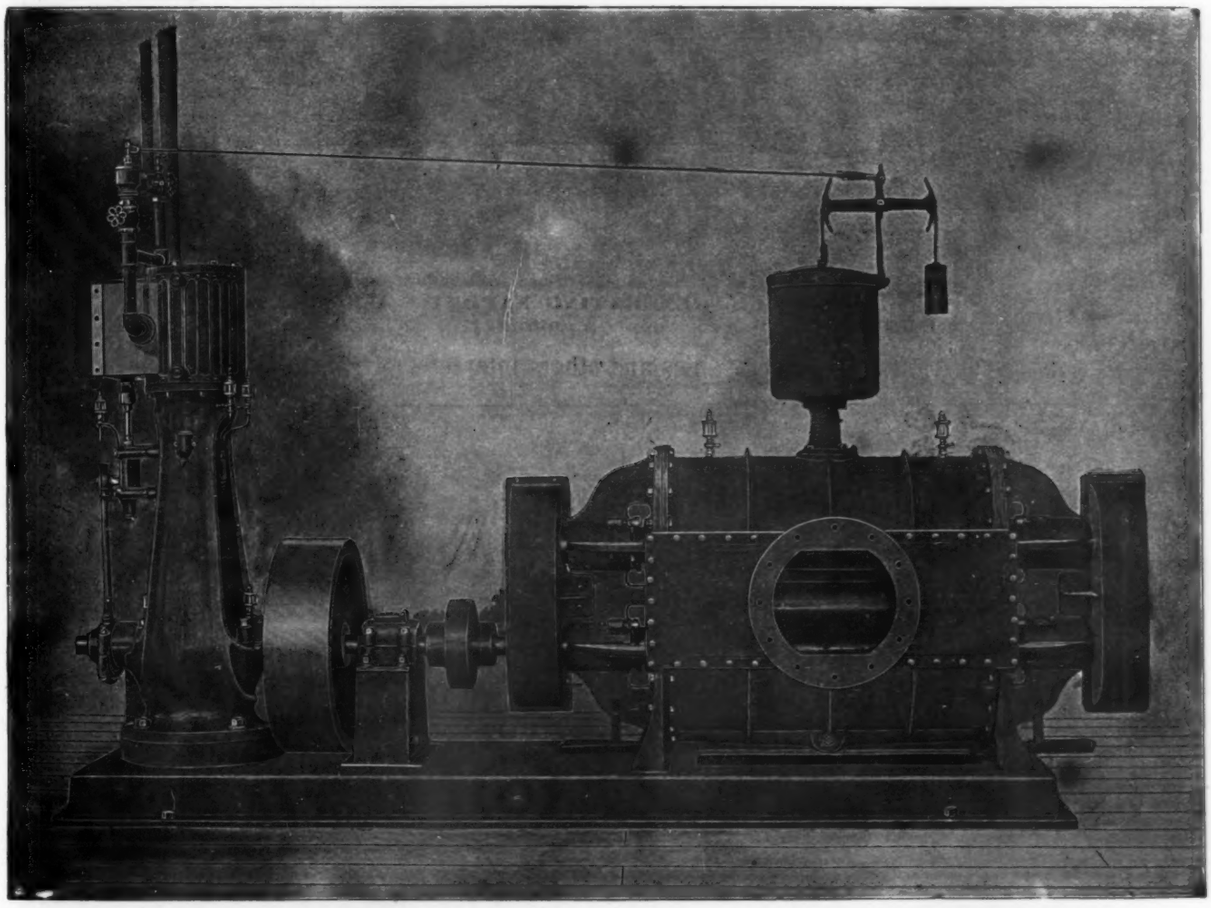

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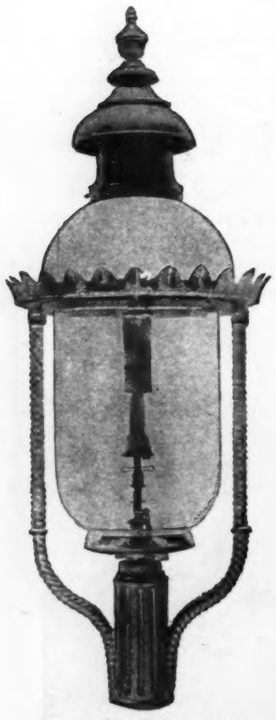

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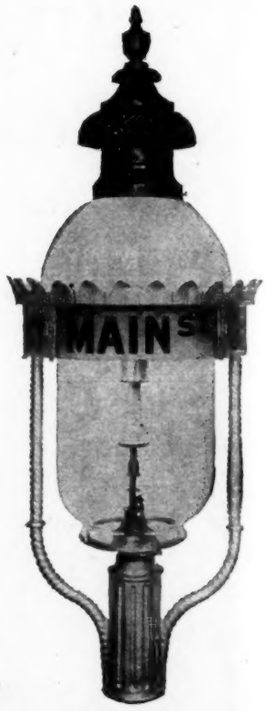

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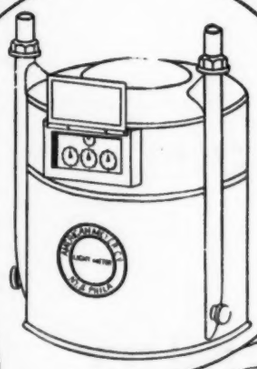

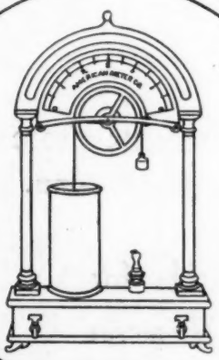

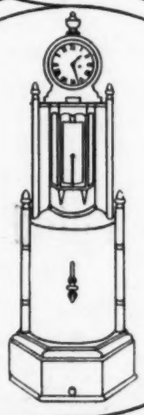

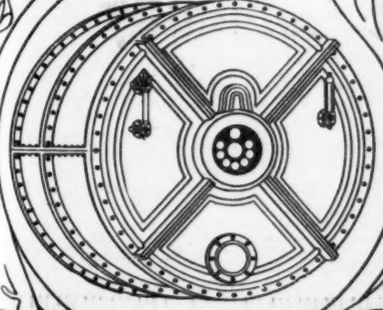

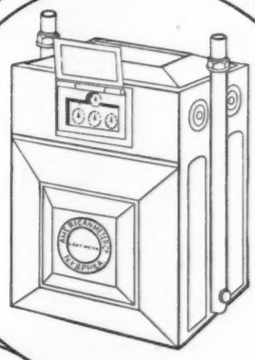

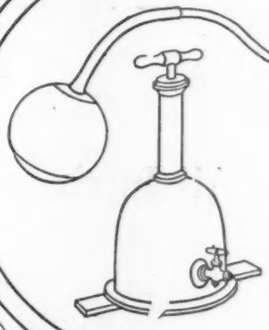

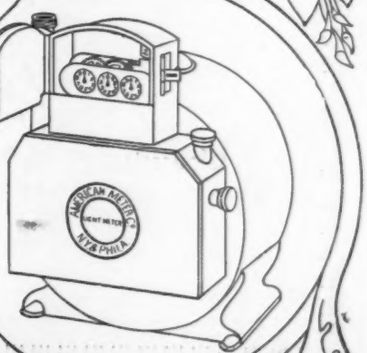

PUBLIC LIGHTING TABLE.

JANUARY, 1900.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Mon.	1	5.20 PM NM	6.20 AM	4.30	6.30
Tue.	2	5.20	6.20	4.30	6.30
Wed.	3	5.20	6.20	4.30	6.30
Thu.	4	5.20	6.20	4.30	6.30
Fri.	5	5.20	6.20	4.30	6.30
Sat.	6	10.10	6.20	4.30	6.30
Sun.	7	11.30 FQ	6.20	4.30	6.30
Mon.	8	12.30 AM	6.20	4.40	6.30
Tue.	9	1.40	6.20	4.40	6.30
Wed.	10	2.40	6.20	4.40	6.30
Thu.	11	3.40	6.20	4.40	6.30
Fri.	12	4.30	6.20	4.40	6.30
Sat.	13	5.20	6.20	4.40	6.30
Sun.	14	No L.	No L.	4.40	6.30
Mon.	15	No L. FM	No L.	4.50	6.25
Tue.	16	No L.	No L.	4.50	6.25
Wed.	17	5.30 PM	8.10 PM	4.50	6.25
Thu.	18	5.30	9.10	4.50	6.25
Fri.	19	5.30	10.00	4.50	6.25
Sat.	20	5.30	11.00	4.50	6.25
Sun.	21	5.40	12.00	4.50	6.25
Mon.	22	5.40	1.00 AM	5.00	6.25
Tue.	23	5.40 LQ	2.00	5.00	6.25
Wed.	24	5.40	3.00	5.00	6.25
Thu.	25	5.40	4.00	5.00	6.25
Fri.	26	5.40	5.00	5.00	6.25
Sat.	27	5.40	6.10	5.00	6.25
Sun.	28	5.50	6.10	5.00	6.25
Mon.	29	5.50	6.10	5.05	6.15
Tue.	30	5.50 NM	6.10	5.05	6.15
Wed.	31	5.50	6.10	5.05	6.15

TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45

Judge Townsend, Of United States Circuit Court,

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Derby, Conn.	1	750,000 "
Lowell, Mass.	1	1,000,000 "
Doylestown, Pa.	1	50,000 "
Darby, Pa.	1	400,000 "
Adrian, Mich.	1	125,000 "
Concord, N. H.	1	400,000 "
Sioux City, Iowa	1	750,000 "
Standard Gas Light Co., New York	3	5,400,000 "
Peekskill, N. Y.	1	250,000 "
Westchester, N. Y.	1	250,000 "
Jersey City, N. J.	1	1,000,000 "
Stapleton, N. Y.	1	750,000 "
London, O.	1	125,000 "
Chicago, Ills.	2	3,600,000 "
Putnam, Conn.	1	125,000 "
Mansfield, O.	1	250,000 "
Plymouth, Pa.	1	125,000 "
Athens, Pa.	1	125,000 "
Charlotte, N. C.	1	250,000 "
Consolidated Gas Co., New York	2	2,000,000 "
Quincy, Ills.	1	250,000 "
Boone, Ia.	1	125,000 "
Webster, Mass.	1	50,000 "
Flushing, N. Y.	1	250,000 "
Total	29	18,650,000 "
Previously built	294	187,100,000 "
Grand Total	323	205,750,000 "

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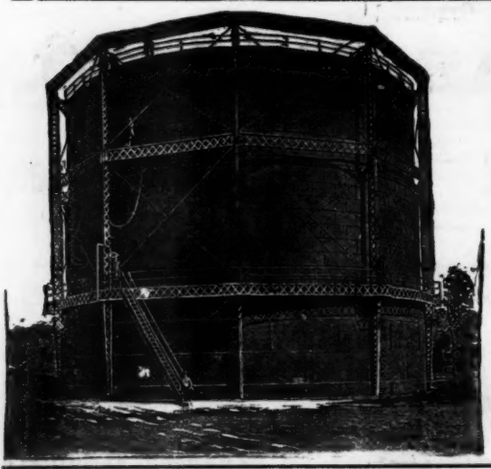

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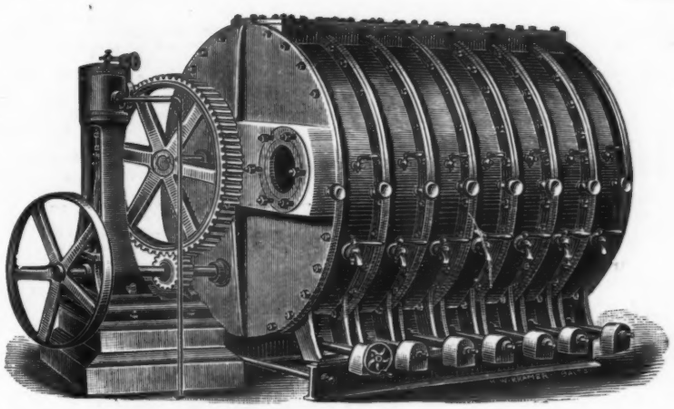

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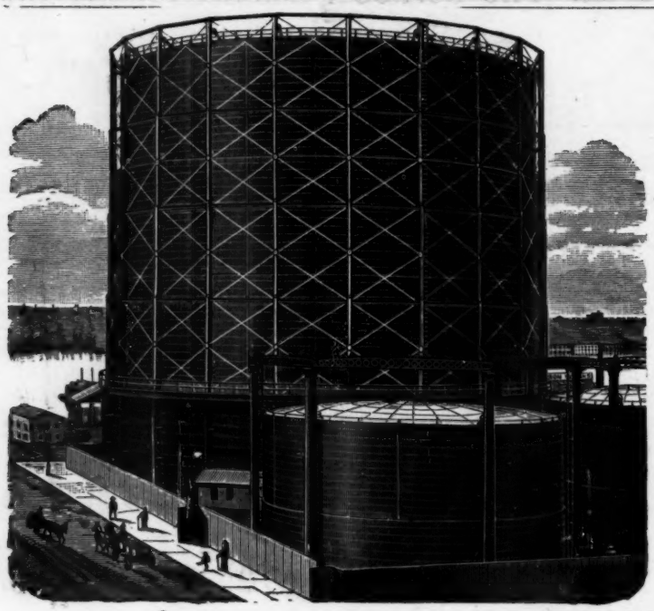

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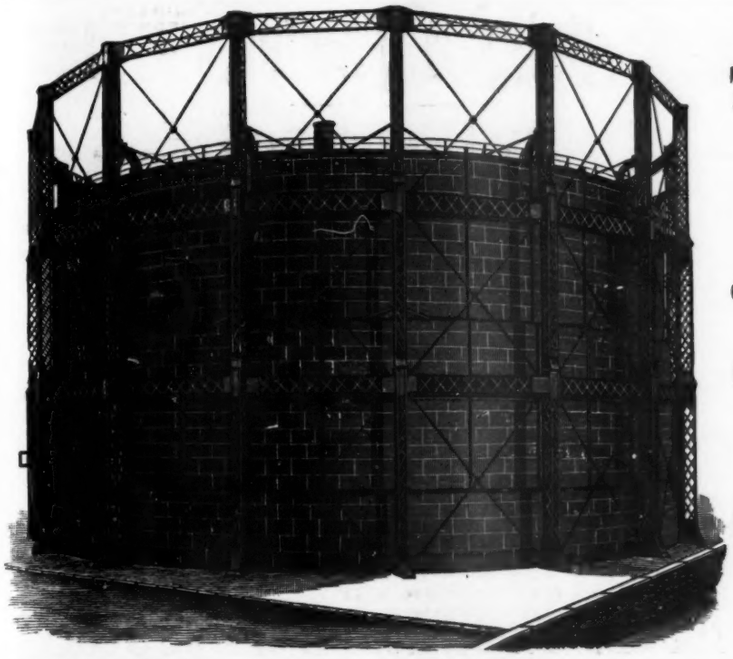

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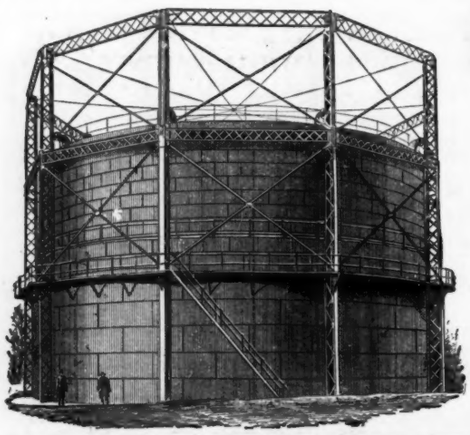

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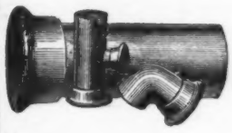

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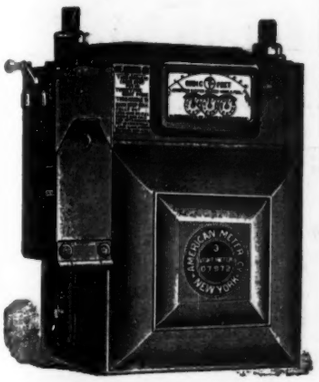

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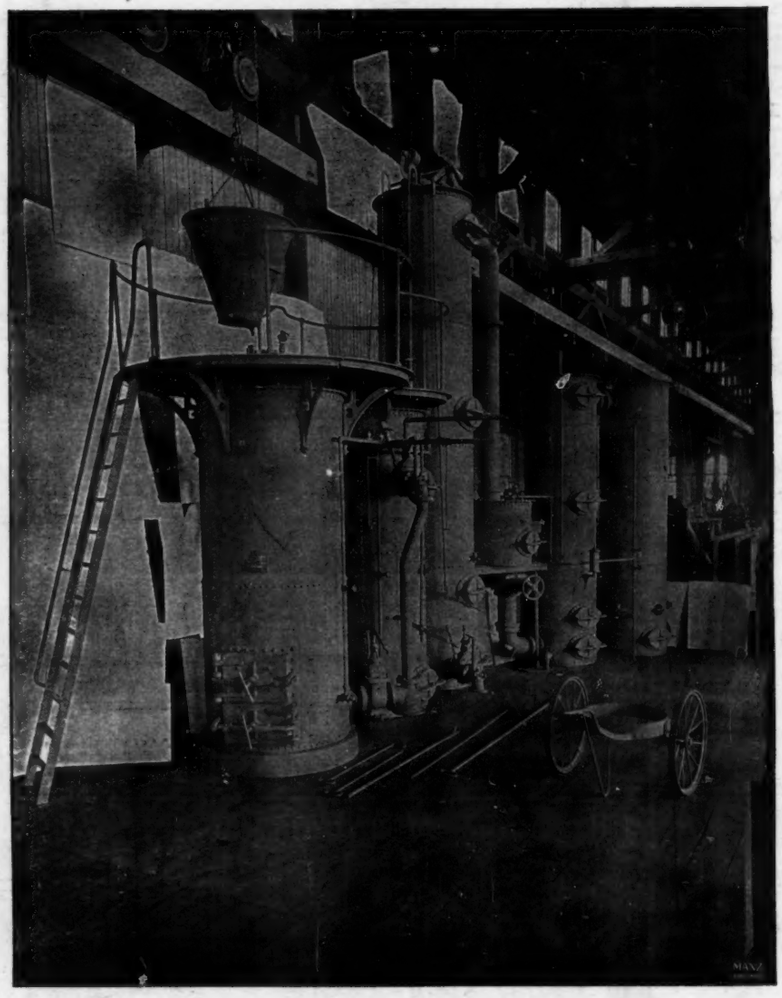

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